THE FOUNDRY

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Molding Friction Drum Castings on Machines

Details of the Lidgerwood Mfg. Co.'s Practice With a Brief Description of the Gray Iron Foundry Operated By This Concern

WITH practice in large, modern foundries well-standardized along up-to-date lines, the equipment and methods of producing castings employed in such plants are largely identical. The buildings are constructed so as to insure adequate lighting and ventilating facilities and to permit of the rapid transportation of raw and finished materials, while the equipment is designed and arranged to provide economical and convenient operating facilities. The majority of foundries, however, show development along certain lines, such as the chemical regulation of mixtures, original methods of mold preparation, systems for routing castings through the shop, etc. A plant which has developed all of its operations to an equally high plane, is that of the Lidgerwood Mfg. Co., located on Frelinghuysen avenue, Newark, N. J. The site is on the outskirts of Newark, on the main line of the Pennsylvania railroad.

The foundry is 120 x 550 feet and

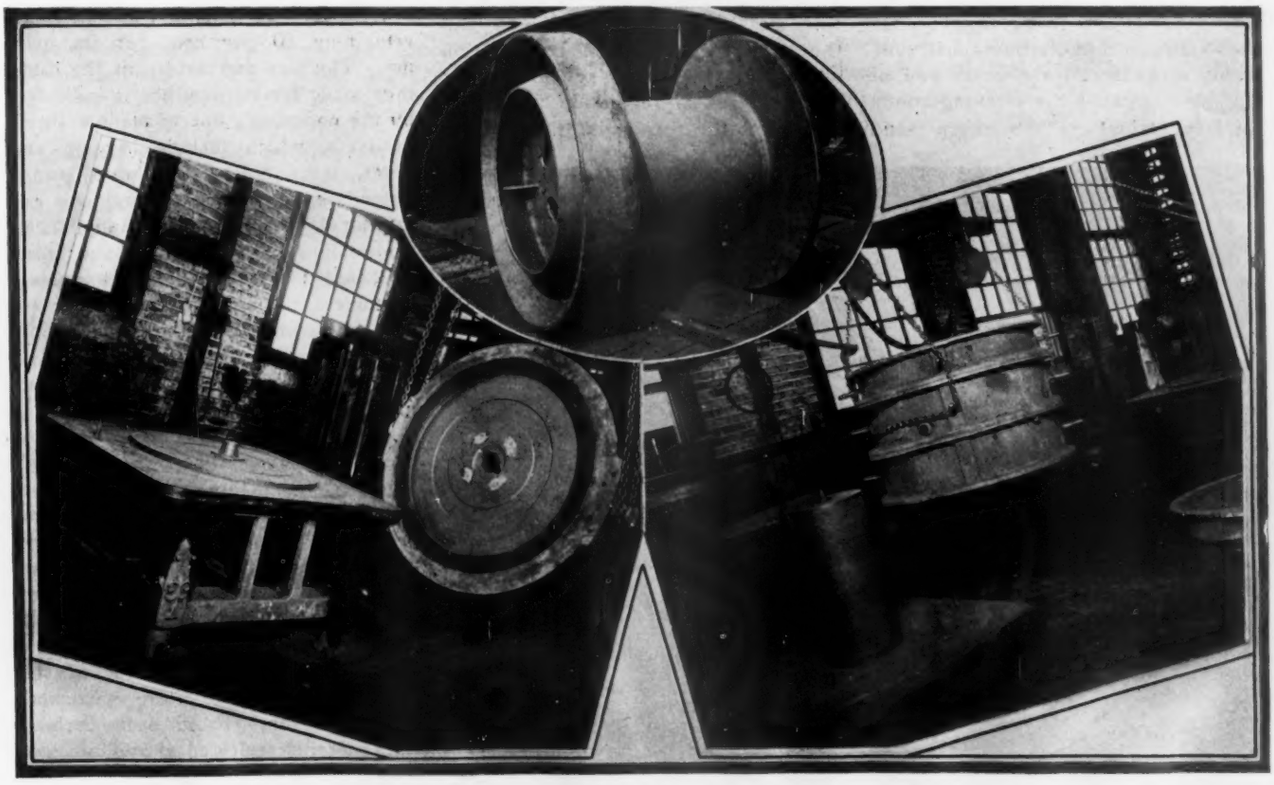


FIG. 2—THE FRICTION DRUM CASTING

FIG. 1—COPE OF FRICTION DRUM MOLD MADE ON A STRIPPING PLATE MACHINE

FIG. 3—SPECIAL MACHINE FOR MOLDING CHEEK OF FRICTON DRUM MOLD

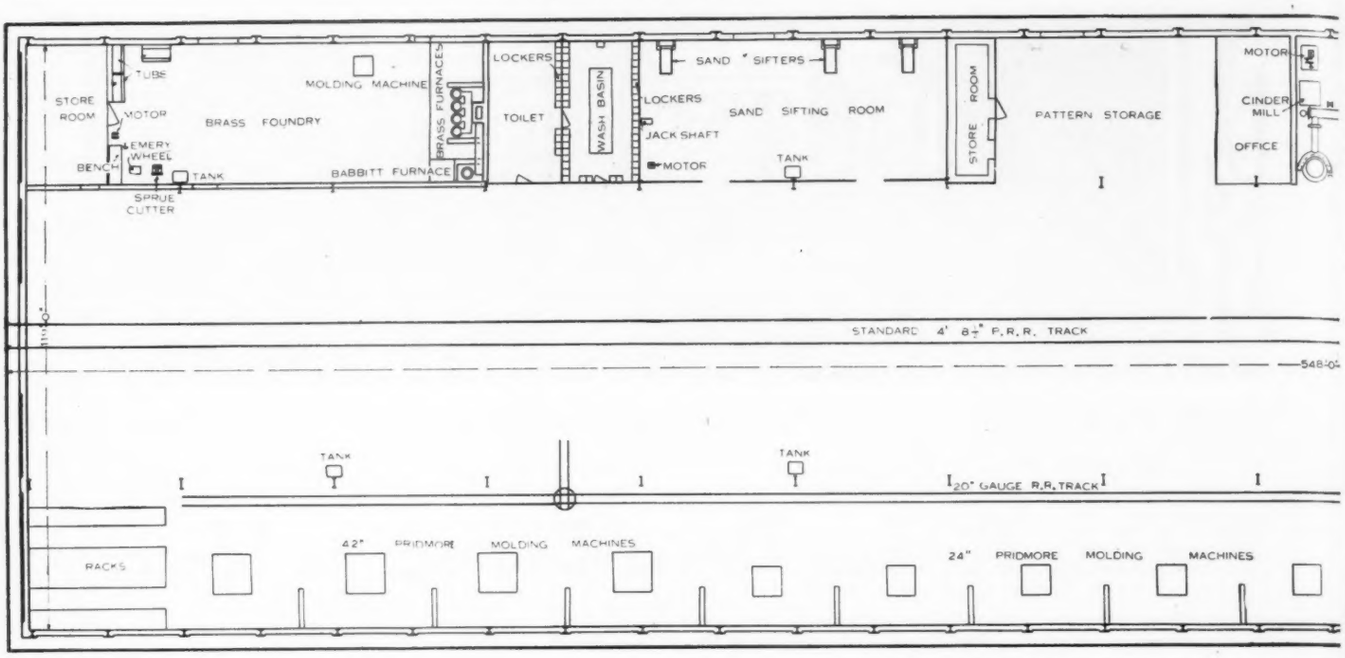


FIG. 4—GOUND PLAN OF THE LIDGERWOOD

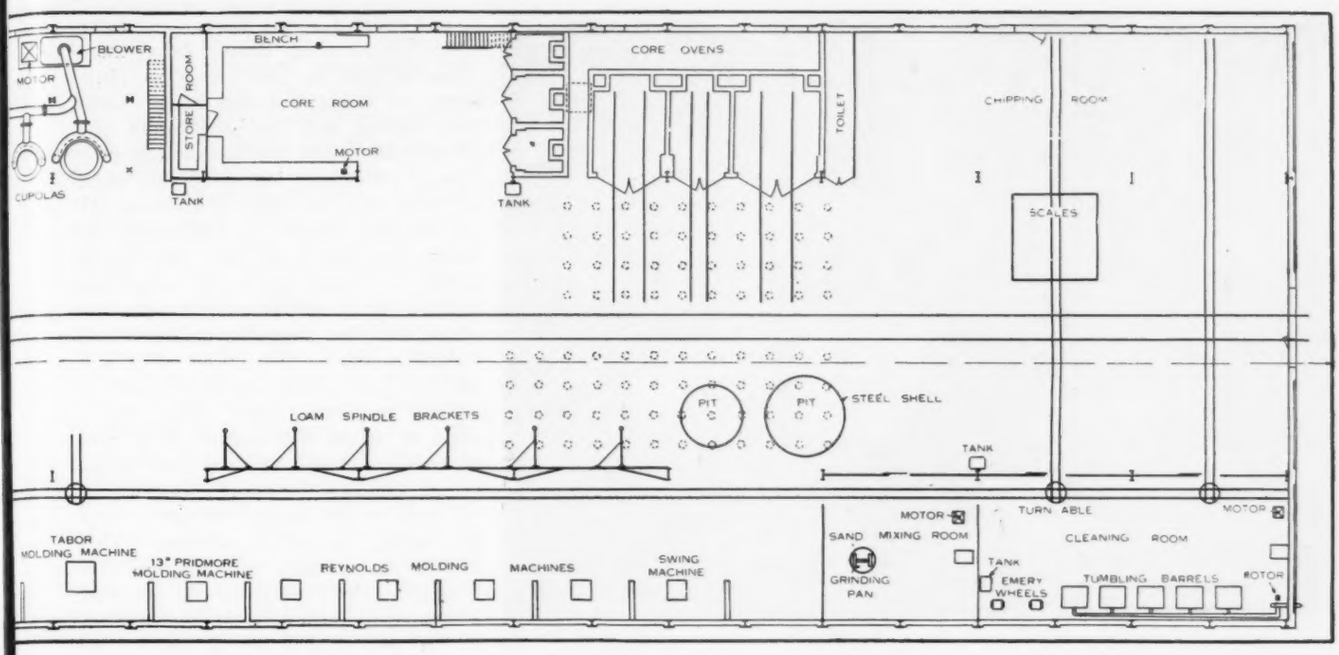
the auxiliary departments include a power plant, 41 x 59 feet; three pattern shop and pattern storage buildings, 30 x 60, 40 x 100 and 41 x 208 feet, respectively, and various sheds and out-buildings for the storage of limestone, coke, sand, brick and other materials. The brass department is located at one end of one of the side bays, as shown in the ground plan of the shop, Fig. 4. The melting equipment consists of four straight-shaft coke-fired crucible furnaces and one babbitt furnace. At the other end of this bay is located the cleaning room, which contains one Pangborn sand blast machine, 10 pneumatic chippers, four grinders, four tumbling barrels, air hoists and a narrow gage track for transporting and handling the castings. The foundry contains a steel rack of ingenious construction for the storage of molding machine patterns, a core room employing 40 coremakers and five ovens for drying molds and cores. One of these is 13 x 25 x 13 feet, two 10 x 25 x 13 feet, and two 8 x 16 x 12 feet. All the ovens are of brick construction with sheet steel doors and are heated by coal fires in regulation fire boxes located at the rear ends of the ovens. The cars enter the ovens on wide gage tracks, being operated by a traveling crane which engages one end of a wire rope attached to the core oven car as indicated in Fig. 6.

FIG. 5—THREE FRICTION DRUM MOLDS READY TO BE CLOSED. THE METHOD OF LOCATING THE CENTER CORE IN SHOWN IN THE FOREGROUND

Castings Produced

The Lidgerwood Mfg. Co. produces from 40 to 50 tons of gray iron castings daily of which about 40 per cent is for the jobbing trade and the remaining 60 per cent for its own use. The size and nature of the castings made for its own use is indicated by the company's line of manufactured products, which include logging engines, mine hoists, cableways, rapid unloaders, contractors' engines, excavators, marine coaling appliances for coaling both alongside and from a vessel in tow, etc. For its jobbing customers, the company produces castings of various descriptions, weighing from a few pounds to many tons. The plant is especially well-equipped for heavy work.

All of the mixtures are made by chemical analysis. The pig iron, when unloaded from the cars, is arranged in piles in the storage yard. These piles are each designated by three numbers, one indicating the location of the pile, a second the number of the car from which the iron was unloaded and a third the lot number which represents the number of the shipment received of the particular brand of iron. From each carload eight pigs are selected at random and sent to the machine shop, where borings are taken. The borings are then put into a package and sealed with a



MFG. CO.'S FOUNDRY AT NEWARK, N. J.

label upon which are marked the three numbers. The package is forwarded to a chemist, who analyzes the sample and returns a slip upon which are marked the percentages of the silicon, manganese, phosphorus and sulphur contents. This slip is then filed in the foundry office for reference.

The gray iron melting equipment consists of three cupolas, respectively 48½, 62 and 80½ inches, inside diameter, and the largest furnace is operated continuously. This cupola is charged with a bed of 2,600 pounds of coke and 4,000 pounds of iron; each succeeding charge consists of 400 pounds of coke and 4,000 pounds of pig iron. After the first eight tons of iron have been charged, limestone is included on the basis of 40 pounds to each ton of iron.

Calculating Mixtures

The grades of iron to be selected for the heat are determined as indicated on the accompanying mixture sheet, Fig. 8. This shows the heat run on June 25. It was desired to secure an iron running about 2.20 per cent in silicon and over 0.50 per cent in manganese. The charges were made up of Crane iron, 10 per cent; Carbon iron, 20 per cent; Thomas iron, 20 per cent, and machinery scrap, 50 per cent. The analyses of these irons were as follows:

Crane, 2.35 per cent silicon, 0.42 per cent manganese, 0.710 per cent phosphorus, 0.029 per cent sulphur.

Carbon—3.13 per cent silicon, 1.02 manganese, 0.935 per cent phosphorus,

Thomas—2.22 per cent silicon, 0.88 per cent manganese, 0.670 per cent phosphorus, and 0.037 per cent sulphur.

Machinery scrap—2.25 per cent silicon, 0.35 per cent manganese, 0.60 per cent phosphorus, and 0.10 per cent sulphur.

The respective amounts of these elements in each grade of pig iron and scrap making up a representative lot of 1,000 pounds of the mixture were then calculated in pounds. This was accomplished by multiplying the percentages of silicon, manganese, sulphur, etc., in each 100 pounds of a grade by the number of 100 pounds units of that particular material used in this 1,000-pound lot. The sum of the percentages of each element in all the grades used was then divided by the multiple 10 to obtain the gross percentage or proportion of each element in 100 pounds of the mixture. The net percentage of each element in 100 pounds of the mixture was obtained by subtracting sufficient allowances for loss by oxidation. In the case of sulphur, however, it is customary to add 0.05 per cent, thereby allowing liberally for the amount of this element absorbed from the coke. The Lidgerwood com-

FIG. 6—A BATTERY OF LARGE MOLD DRYING OVENS SHOWING THE METHOD OF HANDLING THE CARS

FIG. 7—A VIEW OF ONE OF THE SIDE FLOORS SHOWING THE METHOD OF HANDLING THE IRON. THE LADLE IS TRANSFERRED FROM THE OVERHEAD TRAMRAIL TO AN AIR HOIST FOR POURING

pany adheres to one brand of coke of which occasional analyses are made.

The pig iron is transported, one ton at a time, from the storage piles by means of flat cars pushed along a narrow gage track to the elevators, which deliver the material to the charging floor. In order to load the cars to exact weight the average weight of a pig of each kind of iron is obtained and the necessary number of pigs taken from the respective piles.

For the purpose of checking the pre-determined analysis of each day's heat, borings from the gates of castings are analyzed, and the results are filed for future reference. For determining the physical qualities of the iron, test bars, 1 inch square and 14 inches long, are made each day and tested for transversal strength. These generally break at a pressure ranging from 2,150 to 2,300 pounds; iron breaking at a pressure less than 2,000 pounds is condemned.

In addition to the reports of analyses, the Lidgerwood company records in a book all the data relating to each day's heat. This has proved valuable for reference purposes, especially in enabling the company to make a report on the grade of iron used in a particular casting.

Molding Friction Drums

A special molding machine has been built by the Lidgerwood company for the production of friction drums, weighing from 800 to 1,500 pounds each. These drums are for use in hoisting engines and the friction ends vary in diameter from 20 to 36 inches, depending on the size of the engine. It formerly required a day for a molder and his helper to make one drum; by the aid of this machine it is customary for two laborers to make from five to seven drums daily. Each drum is cast in one piece, as illustrated in Fig 2, one end being called the friction end and the other the flange end, while the connecting portion is the barrel. A three-part mold is employed, the drag containing the friction end, the cheek containing the barrel and the cope, the flange end. Both the cope and the drag are molded on a 48-inch Pridmore machine, but the cheek is molded on a special machine. The mold table is a circular iron plate which fits into a square cast iron plate. The square plate is about two inches thick and 40 inches square. It rests over a pit in the foundry floor and has a circular hole in its center through which the barrel pattern is inserted. This pattern is in the form of an iron cylinder with a shoulder at one end which rests on a pin at the bottom of the pit. There are a number of such cylinders, corresponding to the sizes of the drums required and a corresponding number of circular plates with center holes varying in accordance with the diameter of the pattern used. These are placed in

Br. 221 7-09 2M

MIXTURE SHEET.

LIDGERWOOD MFG. CO.—Foundry Dept.

Mixture for C. L. P. Castings

Mixture 329 Newark, N. J. June 25 1912

CAR NO. OR PILE	BRAND	LBS. PER CHARGE	% SILICON	LBS. SILICON	% MANGANESE	LBS. MANGANESE	% PHOSPHORUS	LBS. PHOSPHORUS	% SULPHUR	LBS. SULPHUR	% TOTAL CARBON	LBS. TOTAL CARBON
21	Crane	100	2.35	2.35	.42	.42	.710	.710	.029	.029		
16	Carbon	200	3.13	6.26	1.02	2.04	.935	1.870	.019	.038		
18	Thomas	200	2.22	4.44	.88	1.76	.670	1.340	.037	.074		
March	Scrap	500	2.25	11.25	.35	1.75	.600	3.000	.100	.500		
TOTAL LBS.		1000		24.30		5.97		6.920		.641		
Gross Silicon, Manganese, Phosphorus, Sulphur and Carbon				2.43		.597		.692		.064		
Loss by Oxidation				.24		.059		—		*.05		
Net Silicon, Manganese, Phosphorus, Sulphur and Carbon				2.19		.538		.692		.114		

* Add .05 as safety factor for sulphur in coke

FIG. 8—MIXTURE SHEET

position on the machine by means of an air hoist which commands the floor.

In making the cheek a round iron flask of the required height is set on the plate with the cylinder in the center. A flat, circular core, in four segments, with a hole in the center conforming to the pattern, is then placed in the bottom of the flask. This core is 1½ inches in height and its inner and outer circumferences are concentric with the outer circumference of the cylinder and the inner circumference of the flask. The core is then secured by hanging the four segments, by means of wire, to bolts which extend into the interior of the flask about six inches above the level of the plate. The sand is then shoveled into the flask and rammed, after which the top of the flask is swept-off by a circular sweep. The barrel pattern is then raised out of the mold by means of the air hoist and the cheek is removed in a similar manner.

The next step is to secure the cylindrical dry sand core in the drag, after which the cheek is lowered onto the drag, with the core in the middle. The cope is then placed on top of the cheek and the mold is closed. These flasks are all provided with trunnions which are readily engaged for handling by air hoists. This method of molding has been found to produce an unusually large percentage of perfect castings.

Small Core Oven

A novel type of core drying oven has been installed as shown in Fig. 9. It consists of a ¾-inch cast iron cylinder, 5 feet in diameter and about 6 feet high. In the center of this cylinder and extending through the top is fixed vertically a heavy steel shaft, which serves as an axis for the three circular core racks. These racks are placed above each other at distances of about one foot and are held in place by collars attached to the shaft. The racks revolve around the center shaft, making all parts readily accessible from the oven door. This oven is heated by coke, which burns at the base of the oven in a circular firebox, 26 inches in diameter. This type of oven has a larger core baking capacity per day than the 8 x 16 x 12-foot brick oven. Small cores can be baked satisfactorily in one-half hour, while the heaviest cores can be baked in two hours. As a result of the revolving rack construction, the cores may be placed directly above or at one side of the fire and can be baked slowly or rapidly, as desired.

In a jobbing foundry, one of the most difficult problems is to devise a simple system of storing patterns in such a manner that they may be located at once when desired. The Lidgerwood company has solved this problem in an interesting and efficient manner. As about 60 per cent of its work consists of the manufacture of castings for its own use, and the remaining 40 per cent jobbing work, there are two general divisions in the pattern storage. The main storage is two stories high. On the first floor are located the carpenter shop and pattern lofts Nos. 3 and 4. On the second floor are the pattern shop and lofts Nos. 1 and 2. These two shops are located in the center of their respective floors, with the lofts on either side. As most of the

FIG. 9—ONE OF THE CIRCULAR OVENS FOR BAKING SMALL CORES

patterns are made at the main Lidgerwood plant in Brooklyn, they are provided with a part number before being sent to the foundry. Thus, the pattern for each part of a machine, and its corresponding core box, has a separate number. When received at the foundry, each pattern, with its core box, is also given a location number such as 1—E—10—E. This denotes that the pattern is to be stored on shelf E, table 10, section E and loft 1. A card for the index file is filled out and filed for future reference. Loft No. 4 of the pattern storage contains no tables, since it is used only for the storage of patterns for large engine bed plates, etc. Such patterns are accordingly only given a section and loft number. In loft No. 5, which occupies a large building at one end of the foundry, are stored the patterns belonging to customers. These are numbered and stored away in a manner similar to that previously described. Loft No. 6 is also in a separate building. This loft is devoted to the storage of obsolete patterns. The entire pattern storage system is in charge of one man.

The foundry and auxiliary buildings are lighted by arc lamps. All machinery is electrically operated, the power plant consisting of two 150-horsepower upright Lidgerwood boilers and one 150-horsepower Atlas Corliss engine, direct-connected to a generator. By means of an Ingersoll-Sargent air compressor in the power plant, a constant supply of air, at a pressure of 80 pounds, is maintained for use throughout the plant.

F. L. Davis has been manager of the Lidgerwood Mfg. Co.'s foundry since shortly after it was first placed in operation. He spent four years learning his trade at the foundry of the Mason Machine Works, Taunton, Mass. Following this connection, he was a foreman for five years of the Draper Co.'s foundry, Hopedale, Mass. Prior to his connection with the Lidgerwood Mfg. Co., he operated the foundry of the B. F. Sturtevant Co., Hyde Park, Mass.

The Lidgerwood Mfg. Co. has solved the half holiday problem by operating its foundry one Saturday and closing down the next.

Concrete Foundry Floors

Many foundrymen are interested in the use of concrete floors in certain portions of their shops, but have generally found them unsatisfactory because molten iron will not lie on concrete on account of its porous and, therefore, generally moist condition. Experiments by the Crane Co., Chicago, have shown that if iron borings are used in place of a portion of the gravel mixed in the concrete there will be no difficulty in using it for foundry floors. If the mixture consists of one part cement, three parts sand and five parts gravel, then one of the five parts of gravel is replaced by iron borings. These floors are said to be very satisfactory and perfectly safe.

The Winnipeg, Canada, branch of the H. W. Johns-Manville Co., New York City, has removed into larger quarters at No. 92 Arthur street. The building is 100 x 50 feet, six stories and a basement, and will be occupied throughout by the company's offices and storerooms. A much larger stock of products will be carried on hand than was possible heretofore and an increased force will be employed.

The Cupola---Its Management and Operation

Although Discussed from a British Viewpoint, the Suggestions Are Valuable and Can Be Applied to Any Type of Iron Melting Furnace

IN A PAPER presented before the Birmingham and Newcastle-on-Tyne, Eng., branches of the British Foundrymen's Association, entitled "The Cupola and Its Management," H. Pemberton contended that a cupola should be as simple as possible in construction. The best type has a brick lining that tapers from the charging door to about 18 inches above the tuyeres, the amount of taper being ½ inch to the foot, which permits all descending material to fall loosely without scoring the lining and roughening its surface. Cupolas, two or more feet in diameter, should be slightly contracted inside, at a point just above the top tuyeres in order to obtain perfect combustion of the fuel at the center of the cupola. This contraction of the diameter may be continued to the bottom of the hearth, if a receiver is used, but otherwise the contraction should not extend more than 6 inches below the bottom tuyeres. All cupolas, the speaker believed, should be made with a double row of tuyeres, the number being in proportion to the circumference of the furnace. The number of tuyeres in the bottom row should equal the circumference of the cupola in inches, divided by 18.84, and the number in the top row should equal the circumference divided by 31.41. The tuyere area should be 11 per cent, or one-ninth of the cross-sectional area of the melting zone. The height of the cupola should equal 6½ times the diameter at the melting zone; the distance of the tuyeres from the hearth should be 2 feet, 6 inches; the height of the slag hole should be about 6 inches below the bottom tuyeres and all cupolas should be equipped with drop bottoms, as many advantages accrue therefrom.

Repairing the Cupola

After a hard day's run a cupola will frequently need considerable repairing, especially in the region of the melting zone, which is just above the tuyeres, and the first operation is to chip away the adhering slag. This should be done as cleanly as possible. The depressions in the lining must then be filled with fire clay or ganister, the latter being least affected by the action of the limestone. The ganister is prepared by mixing it with water to the desired consistency, which should be rather stiff, but soft enough to adhere to the lining. A thin layer of ganister is first applied and is made smooth with a brush, commencing at the bottom of the brick lining at its juncture with the hearth. The thin wash acts as a cement and retains the filling of ganister. Portions of old cupola fire bricks can be used with the ganister if the depressions are very deep.

Lighting the Cupola

After the breast has been made and the sand bottom is in place, the fire can be lighted and after it is well ignited, coke is charged to a depth of 18 inches above the top tuyeres. While it is not necessary to weigh the coke, the depth should be carefully measured, as to charge more than 18 inches would be a waste of coke, and less than this amount might involve serious trouble. Under the latter conditions, the iron, as it is charged, would drop too near the tuyeres, which would decrease the depth of the bed and, consequently, would necessitate a start with the melting zone too low. The blast, instead of blowing into the fuel, would eventually blow into the iron, oxidizing the latter and causing a serious loss of iron. Throughout the whole of the heat the metal would be much cooler than if the heat had been properly started. It is, therefore, much better to burn coke than iron on the bed. After the proper quantity of coke has been charged, it is advisable to start the blower, to bring the bed to a state of incandescence before the iron is charged. This allows the sulphur in the coke to escape without entering the iron and less heat is lost, as the lining of the cupola absorbs and stores it.

Charging the cupola is a most important item of its operation. The charges of iron should be in proportion to the diameter at the melting zone, namely 1½ pounds to the square inch. This is found to be excellent in practice as regards fuel economy, speed of melting and the temperature of the molten metal. The proportion of coke depends upon the quality of iron to be melted and may vary from 120 to 200 pounds per ton of iron. The charging should be carried out in an intelligent manner, otherwise the metal will not be melted uniformly, and much difficulty will be experienced. The charging should be carried out evenly in uniform layers of coke and iron, instead of in heaps. The charger should be instructed to keep his cupola filled to the charging door and to spread the coke and iron, because if it is simply dumped in, the iron may settle at one side of the cupola and the coke at the other, with the result that the cupola melts only on one side. When scrap is charged it is more economical to break it into small pieces, as large scrap causes the stock in the cupola to become open and much of the ascending heat is allowed to escape before being utilized to heat the descending material.

The Coke

Both the physical and the chemical properties of the coke must be considered, porosity being not so essential as hardness and density. The very best coke obtainable is none too good for melting iron and is the cheapest in the end. Coke with too great a pore space is not at all suitable for use in the cupola. It will not stand the pressure of the blast without softening and is disintegrated at the melting zone into fine material which is subsequently blown from the stack of the cupola. In such a case an inspection made at the charging door may show that the cupola is apparently working satisfactorily when, in reality, the opposite is the case. Although the coke may prove to be excellent from a chemical standpoint, foundry foremen and managers should recognize the necessity of purchasing coke by chemical analysis and physical properties combined. Until then, the management of cupolas as regards speed of melting, temperature of the metal, coke ratios and fuel economy will remain one of the everlasting foundry problems.

Testing Coke

The tests for indicating the variation in physical properties of different cokes are very simple, and may be carried out in a few minutes. This will afford a fairly good guide as to the quantity of coke required per ton of iron melted, the amount of metal per hour, and the blast pressure necessary to work the cupola successfully. When the coke is received,

take a small average sample, place it in water and note what quantity floats well, how much just floats, and what amount sinks, and then judge from the results obtained. The old method of judging coke by its color is not to be depended upon, neither is it fair to the coke. A very poor quality may have the silver gray color, whereas a very good coke may be dark or nearly black. An ideal coke for foundry purposes is hard, dense and does not break to pieces when dropped from a height of 5 feet onto an iron plate; and most important of all, it sinks when placed into water. If its chemical quality is not below the average for British coke, namely 84 per cent carbon, and 5 per cent ash, a coke possessing the above qualities would give good hot metal with clean melting conditions, when used in the ratio of 13 pounds of pig iron to 1 pound of coke, or 168 pounds of coke per ton of iron melted, and a ratio of 20 to 1 for charges of iron carrying a large percentage of scrap.

Limestone

The amount of limestone to use with this quality of coke should be from 25 to 30 per cent of the weight of the coke charged, a little more being required if the pig iron and scrap carry an abnormal amount of sand and dirt. Coke possessing these chemical and physical properties will require upwards of 36,000 cubic feet of air per ton of iron melted. Although the amount of air chemically consumed by 168 pounds of coke is only 23,856 cubic feet, in practice it is found that upwards of 41,000 cubic feet of air are required for the combustion of that amount of coke, owing to the fact that the blast must be driven into the cupola at sufficient pressure to reach the center of the fuel charge. More air, therefore, has to be driven into the cupola than is chemically required to consume the coke.

The heat produced from 168 pounds of coke equals 2,276,000 B. T. U., and to work efficiently, these heat units must be produced as quickly as possible. This is very essential, because when not produced rapidly very little melting is done. An ordinary open grate fire will illustrate this point, as it shows that the heat units can be produced so slowly that the heat never reaches the melting point of iron, no matter how much fuel may eventually be consumed. Therefore, it is necessary that the heat units be formed as rapidly as possible in the cupola as each layer of coke descends to the melting zone, and this can only be accomplished by having a sufficient volume of air under pressure.

There are many other grades of coke other than the ideal coke just considered and one of these lacks hardness, strength and density; when placed in water it floats with about three-quarters of its bulk submerged, and when dropped from a height of 5 feet onto an iron plate, it breaks into pieces, thus showing that it is too soft. This coke would not, therefore, withstand the crushing weight of the charges and the rough usage to which it would be subjected when descending to the melting zone. Consequently it would not bear the pressure of blast necessary for rapid melting in the same degree as the ideal coke first dealt with. Although soft coke may possess the same chemical composition as hard fuel, and, in theory, requires the same amount of air for combustion, in practice the supply of air would have to be extended over a longer period, and at a pressure of 35 per cent less than the hard coke. The air pressures required in both cases are 13.5 inches of water for the hard coke, and about 9 inches for the soft.

More careful attention to the cupola will be necessary in the case of the soft coke than for the hard, as the former fuel will reach the melting zone in a more or less crushed state, the result being that the liquid slag becomes mixed with a portion of the crushed coke, and is chilled by the blast. This will cause it to gather around the tuyere openings, and to form a nucleus upon which some of the molten iron drops and solidifies instantaneously, resulting in the building up of a mass of crushed coke, slag and iron, which may cause scaffolding. In addition, a considerable amount of coke is lost in the form of dust. To melt successfully with a soft coke, it is necessary to use from 20 to 30 per cent more than is required in the case of hard coke, which, of itself, causes an extension of the melting zone upwards, a condition undesirable in cupola practice. It is necessary, also, to use from 25 to 30 per cent more limestone to obtain clean working conditions, although by so doing the melting rate is decreased by from 20 to 50 per cent per hour.

Another Soft Coke

A still softer variety of coke than that last mentioned is known and can be recognized easily, because it floats with about 25 per cent of its bulk submerged. It may have the same analysis as the preceding cokes, and requires, theoretically, the same amount of air for combustion, but it will crush under the burden of the charge, and instead of being good, solid coke at the melting zone, becomes a kind of coke dust on which the liquid slag and drops of iron settle and form a growing mass. It will not withstand the pressure of the blast required to reach the center of the cupola and the carbon at this point is not burnt to carbon dioxide, but a large quantity is fluxed away with the slag. While it is possible to use this quality of coke when not more than 12 tons of iron are required in a cupola of not less than 30 inches diameter, this can only be done by reducing the blast pressure to 6 inches of water, and increasing the quantity of coke by 40 per cent over the hard quality. As the coke dust and slag become mechanically mixed, it is necessary to use 50 per cent more limestone to get them out of the cupola and to keep the latter clean. This is detrimental to the lining, owing to the fact that the extra limestone very seriously attacks the silicon in the bricks.

Coke Problem Summarized

In using this quality of coke, it will be found that the lining, after a heat, has been worn away 100 per cent more than it would with a hard coke. In addition the melting rate is reduced from 6 to 2 tons per hour. It is always better, therefore, not to use this kind of coke for melting iron, as no economy will result, even if it can be procured much cheaper. Summarizing the coke question, the author placed emphasis on the fact that cupola coke must be sufficiently hard to withstand crushing and rough usage, without balling, when descending from the charging door to the melting zone. It should be, roughly, in 4-inch cubes, its density being greater than that of water. It must not break to pieces when dropped from a height of 5 feet onto an iron plate, and should possess the approximate composition of from 90 to 94 per cent of carbon, 5 to 10 per cent of ash, and not more than 1 per cent of sulphur. With these properties the air from the tuyeres would have a free passage to the center, which is necessary where economy is considered.

If the coke that is charged into a cupola contains from 5 to 10 per cent of ash, and the pig iron and scrap a quantity of sand and dirt, as the melting operation proceeds, these incombustible substances accumulate and will soon choke up the cupola and stop the melting. Therefore, they have to be removed, and in or-

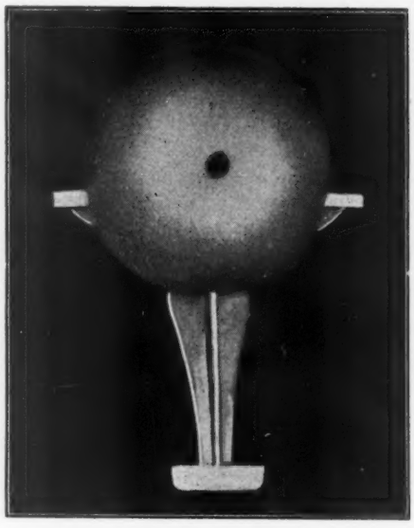
der to accomplish this the accumulation of matter must first be made fluid, and to do this a fluxing agent is necessary. For general purposes limestone is the best and most economical flux to use in the cupola. The amount to be used will depend entirely upon the condition of the pig iron and scrap, and where this carries about 4 per cent of sand and dirt, and the coke from 5 to 10 per cent of ash, the amount of limestone required for clean and efficient working will be about 48 pounds per ton of iron charged. By the use of this quantity excellent working conditions of the cupola are obtained, the slag runs fluid, and is not stiff, strong or spongy. The lining of the furnace is not scoured away by the action of the lime on the silicon in the fire bricks, and most important of all, there is no accumulation of material at the tuyere openings. The slag falls onto the molten iron on the hearth and forms a covering or protection for the metal from the action of the blast. The coke burns brightly at the tuyeres, thus showing that the cupola is in an excellent condition at the melting zone. Cupolas, 30 to 50 inches in diameter, should be slagged after melting every 5 or 7 tons of iron. The slag hole should be opened, when the slag will either be forced or blown out by the pressure of the blast. It must not, however, be open for more than 15 minutes, otherwise a loss of heat from the cupola will result. If left open an abnormal length of time, a reduction in the rate of melting takes place. Care should be taken not to remove all the slag from the hearth, as it makes a very good covering for the metal.

Amount of Limestone to Use

It is better to use a little too much limestone than not enough, but an extreme in either direction must be carefully avoided. Insufficient limestone is responsible for many troubles, among which may be included a dirty cupola and cold iron. In addition, the melting rate will fall from 20 to 30 per cent. Too much limestone is detrimental to the cupola lining, as it scours out the latter to a great extent, especially in the region of the melting zone, and with a melt of 25 or 30 tons, the lining may be cut away to a depth of 8 or 10 inches. Where receivers are used there is danger of the slag scouring the lining away as it runs from the cupola to the receiver, even to the extent of cutting through the casing. Where no receiver is used, the slag, as it runs from the cupola, scours out the slag hole to twice the normal size, and when the cupola is working it boils up into a spongy mass, which may be carried into the melting zone by the blast. Instances have been known where the slag has been at the tapping hole and as high as the tuyeres at the same time, even when the slag hole has been open for some considerable time. Great difficulty is experienced in getting such slag out of the cupola owing to its spongy nature, and the slag hole must be left open throughout the heat after the first three tons of metal have been melted. As a hole continually increases in size, a great amount of heat is lost, and extra coke is required for the cupola.

Tapping the Cupola

After the metal is melted it should be drawn from the cuopla as uniformly as possible, according to the melting rate, the weight of the charge being taken into consideration to insure a complete mixture of the pig iron and scrap. The cupola should not be drained or worked from the bottom, and where the charge of iron ranges from 800 to 1,400 pounds, from 600 to 2,000 pounds of metal should always be left in the furnace. This allows for the withdrawal of metal in tappings of 1,000 pounds, for castings of heavy section, and proportionate tappings for castings of lighter section and insures a uniform quality of iron for all classes of work. If the metal is not taken off uniformly, but at the rate of 2,000 pounds at one tap, then 500 pounds and next 2,500 pounds, the melting zone is being altered continually. It rises and falls as the stock on the hearth rises and falls, with the result that the melting rate cannot be kept constant. Neither can the tuyere openings be kept bright, and very often, owing to bad management in taking metal out of the cupola more coke is charged. With a little study of the question of coke and limestone, a cupola can be brought into perfect control by adopting fixed melting rates and coke ratios, and will thus cease to be the subject of so much controversy among foundrymen.



CAST ALUMINUM FLOAT BALL

Aluminum Founding in Mexico

A hollow sphere is always considered a difficult casting to make, because the core, being almost entirely surrounded by metal, has a tendency to blow if the vent is not taken off freely and rapidly. It is interesting to note that such castings are being made successfully in a Mexican brass foundry, as it shows that skill in founding is not limited to any one country. The castings are hollow aluminum float balls, 8 inches in diameter, 5 pounds in weight, and having a metal thickness of 3/16 inch. At one part of the circumference a long stem is attached, and at two other points are two lugs, as shown in the accompanying illustration. In order to anchor the core and take off the vent, an opening is provided in the sphere about 5/8 inch in diameter, which is afterward closed. This is about as small as it is possible to make such a hole and proves that considerable special rigging was required to secure the core and to provide for the vent. This was probably accomplished by means of a perforated tube anchored at one end in the core and provided at the other end with suitable means for either suspending the core or anchoring it firmly in the drag of the mold. In the case of aluminum, the core would have to be made especially soft and friable, otherwise the casting might be cracked or the metal would not lie against the core. These castings were made by the Fundicion De Bronce, Torreon, Mex.

The Rockwell Furnace Co., New York City, has received an order from the Ford Motor Co., Detroit, for the installation of 24 core ovens containing 88 shelves. Each shelf is circular in form, 5 feet in diameter and turns independently on a central axis. One-half of the shelf is in the oven on which the cores are placed while being baked, and the other half is outside of the oven and serves as a rack. Producer gas will be used as fuel.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form

USEFUL INFORMATION FOR THE FOUNDRYMAN

Comparative Heat Value of Fuels

The unit of heat generally used for practical purposes is known as the British Thermal Unit (B. T. U.) and represents the amount of heat required to raise 1 pound of water, 1 degree Fahr., when at a temperature of 60 degrees Fahr. Its mechanical equivalent is 772 foot-pounds. A comparison of the heat values of various fuels is made in the following table:

Fuels.	Heat Value in British Thermal Units, Per Pound.
Anthracite coal	12,900 to 14,800
Acetylene gas	20,700
Bituminous coal	12,500 to 16,200
Charcoal	13,700
Coke	12,000 to 14,500
Carbon, complete combustion	14,500
Coal gas	19,850
Hydrogen to water	52,740
Peat	7,400 to 10,200
Wood	4,800 to 7,800
Natural gas	22,000
Marsh gas	23,500

The thermal value of any fuel will vary according to the amount of moisture contained therein.

Weights of Different Fuels and the Space Required for Storage.

Fuel.	Weight, Pounds Per Cubic Foot.	Cubic Feet Storage Space, Per Ton of 2,240 Pounds.
Anthracite coal, market size, piled loosely	52 to 56	40 to 43
Bituminous coal, broken, piled loosely	47 to 52	43 to 48
Dry coke	23 to 32	80 to 97

From 100 net tons of coking coal there are produced 65 tons of coke in beehive ovens, and in by-product ovens there are obtained 75 net tons of coke, 1,000 gallons of tar, 2,500 pounds of sulphate of ammonia, and 450,000 cubic feet of illuminating gas.

FORMULAS FOR THE BRASS FOUNDRYMAN

Mixtures of Brass and Bronze Alloys Used in English Practice

Class of Service.	Copper, Lbs.	Tin, Lbs.	Zinc, Lbs.	Lead, Lbs.	Yellow Brass, Lbs.	15 Per Cent Phosphor-Copper, Lbs.
Bearings, heavy	84	14	2	0	0	0
Bearings, small	83	12	0	5	0	0
Bearings, engine	112	13	½	0	0	0
Bearings, heavy	160	25	5	0	0	0
Brass, common	112	0	56	0	0	0
Brass, dipping	112	0	36	0	0	0
Brass, coarse	112	0	56	10½	0	0
Copper flanges	112	0	14	0	0	0
Copper rivets	112	0	0	0	40	0
Coppersmith's solder	112	0	20	0	0	0
Clock metal	112	10	0	10	0	0
Condenser linings	112	7	28	7	0	0
Gilding metal	56	0	0	0	42	0
Marine engines	112	10½	10½	0	0	0
Marine bearings	112	17½	8	0	0	0
Muntries mixture	112	0	20	0	0	0
Pistons	112	14	0	0	14	0
Piston rings	87	10	0	0	0	3
White metal	12	64	168	0	0	0
Hydraulic metal	112	12	0	0	28	0
Phosphor bronze	112	12	0	0	0	6
Soft bronze	112	7	6½	4½	0	0
Red metal	112	5	12	4	0	½

Casting An Iron, 120-Ton Engine Bed Plate

How This Was Accomplished in the Mesta Machine Co.'s Foundry—Melting the Iron, With Details of Shaking-Out

THE Mesta Machine Co., Pittsburgh, recently cast an engine bed which required 260,000 pounds of metal, the net weight of which was 240,000 pounds or 120 tons. The casting is one of the bed plates for an engine that is being built by the Mesta Machine Co. and which will be installed by the Youngstown Sheet & Tube Co., Youngstown, for operating its blooming mill. Two large bed plate castings will be required, the second being a duplicate of the one illustrated herewith.

As 130 tons of metal were required to pour the mold, the iron was tapped simultaneously from five air furnaces, each furnace being charged with iron of the same average analysis. The melting of the metal was so regulated that all of the furnaces were ready to tap at approximately the same time. The metal was tapped into six ladles, four of which were poured at one time and after these were emptied the contents of the remaining two ladles were emptied into the mold.

In Fig. 1 is shown the mold made in a pit in the foundry floor. It will be noted that binders were placed across the mold throughout its entire length. These were held in position by rods extending through the bottom plate. Bottom-pour ladles were used, the same as are generally employed for casting steel. This large mold was poured in an exceedingly short period, as only 17 minutes elapsed from the time when the metal was tapped into the ladles until the mold was filled. The casting was allowed to cool slowly in the sand and was not shaken-out until it had remained in the sand for a period of 16 days. The removal of this casting from its pit presented an interesting problem owing to its great weight, which, including the cores, must have approximated more than 200 tons. The sand first was removed from around the sides of the casting and each end was gradually raised until the entire casting was clear of the pit. This permitted the removal of the cores and facilitated the subsequent handling of this large bed plate.

Fig. 2 shows one end of the casting elevated by means of two cranes

FIG. 1—POURING A 240,000-POUND IRON BED PLATE CASTING IN THE FOUNDRY OF THE MESTA MACHINE CO., WEST HOMESTEAD, PA.

FIGS. 2 and 3—HOW THE CASTING WAS REMOVED FROM THE SAND, ONE END AT A TIME, BY TWO LARGE CAPACITY TRAVELING CRANES

which supported an equalizer beam, clearly shown in Fig. 3. The opposite end of the casting raised out of the pit is illustrated in Fig. 3. It will be noted that the equalizer beam is supported by the hooks of two traveling cranes. The end of the casting was engaged by chain slings which pass through links supported by the equalizer beam. After the cores were removed the gates, heads and risers were cut off. The net weight of the casting was 240,000 pounds and after cleaning was more readily handled in the foundry by two cranes than when the cores were still in place.

The bed plate, ready for shipment, is illustrated in Fig. 4. It will be noted that a special steel flat car was required, having a capacity of 200,000 pounds and a length of 36 feet. The casting was without a defect.

Bearing Alloy

Owing to the high price of tin, the Hungarian State railways have adopted a new anti-friction alloy, consisting of lead, 78 per cent; antimony, 17 per cent, and tin, 5 per cent. The melting point of this alloy is said to be 432 degrees Fahr. It has been tested for three years and has proved entirely satisfactory.

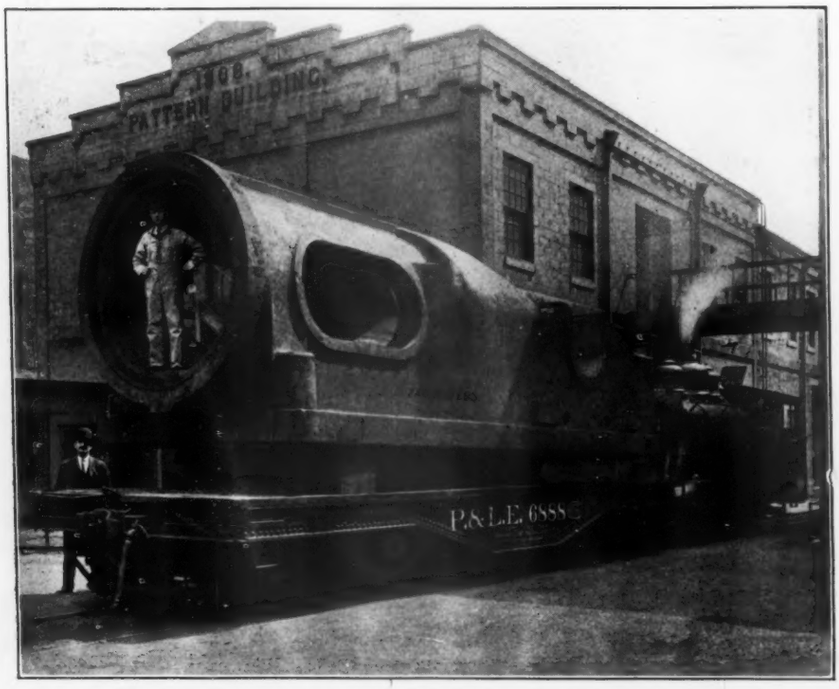


FIG. 4—THE BED PLATE CASTING READY FOR SHIPMENT

Excessive Slag

By W. J. Keep

Question.—We are experiencing considerable trouble from excessive slag. Our cupola is lined to 36 inches, has a tuyere area of 188 square inches and the blast is furnished by a fan at a pressure of 16 ounces. We charge 700 pounds of coke on the bed, which raises the latter to a height of 18 inches above the tuyeres; 2,000 pounds of iron are charged on top of the coke bed. The succeeding charges contain 110 to 115 pounds of coke to 1,000 pounds of iron. Is it not a fact that the difficulties experienced are due to the excessive oxidation of the iron, arising from the low bed and the high melting zone, which results from the high blast pressure? It also seems to us that the volume of air is excessive. What size charges do you recommend for a cupola of these dimensions and what should the air pressure be?

Answer.—You can melt satisfactorily with a pressure of from 8 to 10 ounces and you probably will obtain better results than with the high pressure you now employ. A lower pressure will bring down the melting zone and the slag will not chill around the tuyeres as much as if a higher pressure is employed. The charges are correct and the bed is not too low. If you are obtaining hot iron you are doing remarkably well for this size of cupola. If you are experiencing trouble from slag it should be tapped as soon as a sufficient amount has accumulated to permit it to run. Reference to the various numbers of THE FOUNDRY published during the year will give you the necessary information regarding the preparation of your cupola and drawing off the slag.

THE BRASS FOUNDRY

Design for Gated Metal Patterns

By C Vickers

THE manner in which metal is permitted to flow into a mold—the size, shape and location of the gate—constitutes an essential feature in the production of perfect castings. Opinions may often differ in regard to the best method of gating, especially in the case of heavy castings, and it is not impossible to obtain good results by diametrically opposite methods. If a large casting is lost, the cause is sought, and if it is found to be due to improper gating, changes are made that insure future success. In the manufacture of small castings, however, it is rare that the losses from defective gating reach a very large percentage of the total number of castings produced, otherwise immediate changes would be made; the losses may be only 10 per cent or less and may continue unnoticed for a considerable time, or they may be attributed to other causes more difficult to correct than the gating, and, therefore, are considered largely unavoidable.

Considering the large number of improper methods by which patterns are gated, it is surprising that more castings are not lost from this cause. In the case of brass castings, it is rare that the prevailing pouring methods are taken into consideration when a set of small patterns is being attached to a gate; otherwise, it would be obvious that the method followed for work that is cast with the molds level would be liable to produce more or less defective castings in the case of molds that are poured on an incline.

Mold Poured From One End

Experience has shown that, with few exceptions, the best results are obtained when small brass castings are poured from one end of the mold, with the latter inclined from the pouring head, as illustrated in Fig. 5. When the mold is inclined in this way the metal first runs to the bottom of the main gate or runner, and then begins to fill the bottom castings first, after which it ascends the incline, and fills the other castings in succession. Therefore, it is evident that the gate should be constructed so as to preclude the possibility of the molten metal partially filling any of the castings on its downward rush, otherwise the metal in the partially filled casting may cool before the metal returns, and thus produce defects that will increase, to a considerable extent, the percentage of loss.

At the left of Fig. 2 is shown a gate of nuts attached to the runner in the usual manner. This gate is only adapted for flat pouring, with the sprue set in the center of its length in the manner pursued with snap flask molding. Provided the castings are thin and light, there is no objection to this method of gating when the mold is cast flat. However, if the sprue is located at the end of the runner and the mold is inclined, some of the metal, in its downward rush, will flow through the cross gates into the casting cavities and will settle, as shown by the

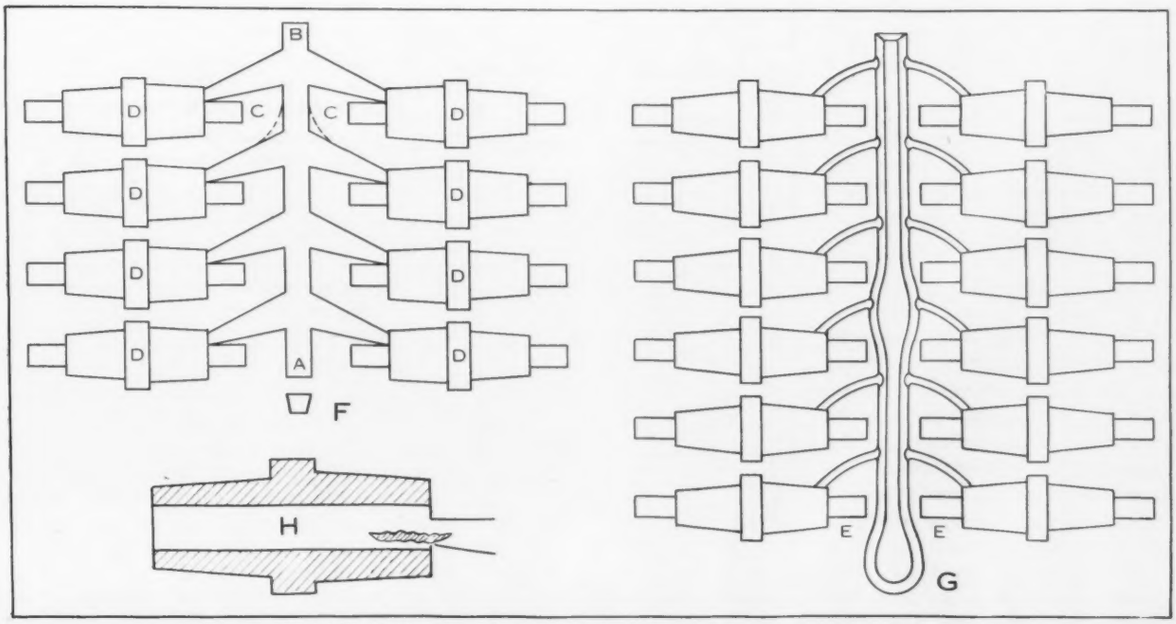


FIG. 1—TWO METHODS OF GATING SMALL BUSHINGS CAST IN BRONZE, THE CROSS-SECTION SHOWS POSSIBLE DEFECTS

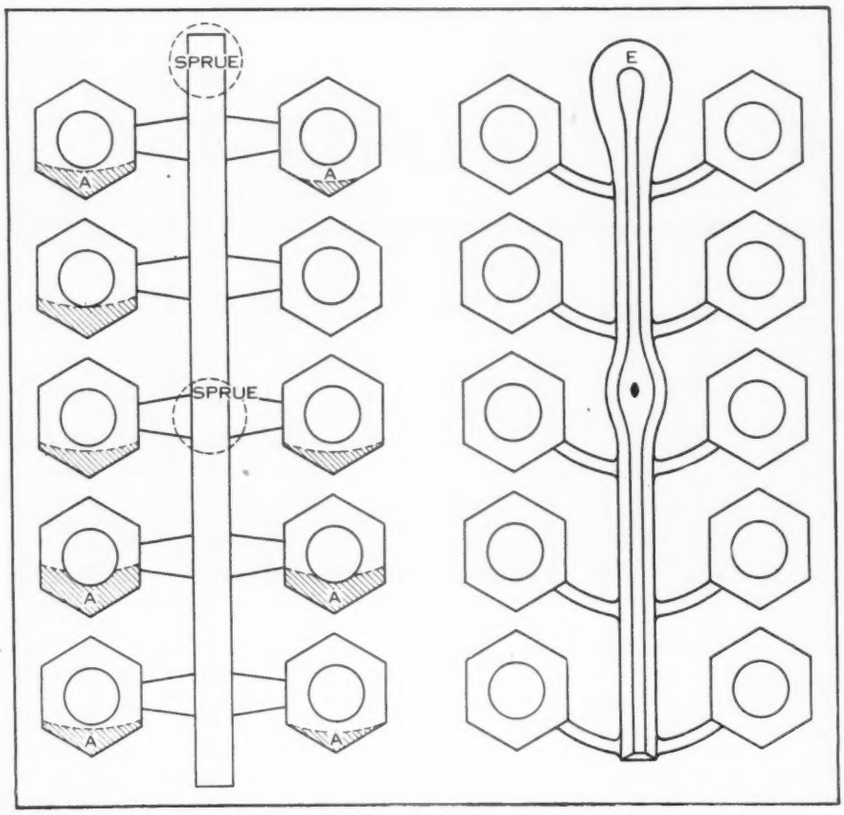


FIG. 2—A CONTRAST OF PREVAILING METHODS IN GATING BRONZE NUTS

shaded portions, *AA*, Fig. 2, where it will remain for a period of time that will vary with the distance of the casting from the bottom of the runner. During this period the metal may chill to an extent sufficient to produce a cold shut at the point of juncture of the new metal, or it may cause defects by filling the rest of the cavity with steam, or by burning and drying one part of the mold while the rest remains green, it may produce a shrinkage of the sand that will cause it to flake off, making a dirty casting.

From a gate of ten castings, there is sure to be one or more that will be rendered defective by some one of these causes and thereby increase materially the percentage of loss from defective castings.

Good Method of Gating

At the right of Fig. 2 is illustrated a method of gating that will give the greatest percentage of perfect castings when the mold is poured from one end and inclined in the usual manner; the pouring end is enlarged as shown at *E*, and the gate is double, half in the cope and half in the drag. The connecting gates to the castings are formed of round brass rods, 5/16 inch in diameter. They are curved in such a manner that the metal will not enter the casting cavities until it returns from the bottom of the gate. Each casting is uniformly filled with metal from its lowest point; the metal does not strike the core, and the metal carried by the cope part of the runner is available for feeding the castings, thus eliminating all trouble from drawing at the gates. The runner is formed by two separate castings, details of which are shown in Fig. 3. The sprue end is enlarged to a dish in the drag part of the runner, and to an egg-shaped extension in the cope. The object of this formation is to facilitate the insertion of the sprue cutter, and to provide a dish into which the metal can drop when the mold is being poured. The cavity in the cope, formed by the egg-shaped extension, prevents the sand at *AA*, Fig. 4, from being crushed into the mold when the sprue cutter is inserted in the cope after the latter has been lifted off, as is usual in brass molding. The sprue, of course, can be cut before the cope is lifted off, but even then the enlargement of the sprue is to be recommended, as its advantages are obvious. Owing to the great cleanliness of the molds necessary in brass founding, it is advisable to try on each cope before each mold is cleaned, in order to press back to place all loose edges around the gates and molds, which otherwise would be blown away by the air. When the cope is tried on, the sprue is extended in width for the head, and the dirt that drops to the bottom of the sprue is blown out when the cope is removed. The final cleaning of the mold is speedily accomplished by tilting the mold on edge and blowing the dirt from the highest parts first; thus gravity aids in the removal of the dirt, which is pursued by the air from cavity to cavity in a downward direction, until it is blown clear of the mold.

When brass castings of the highest quality are required, the molds must

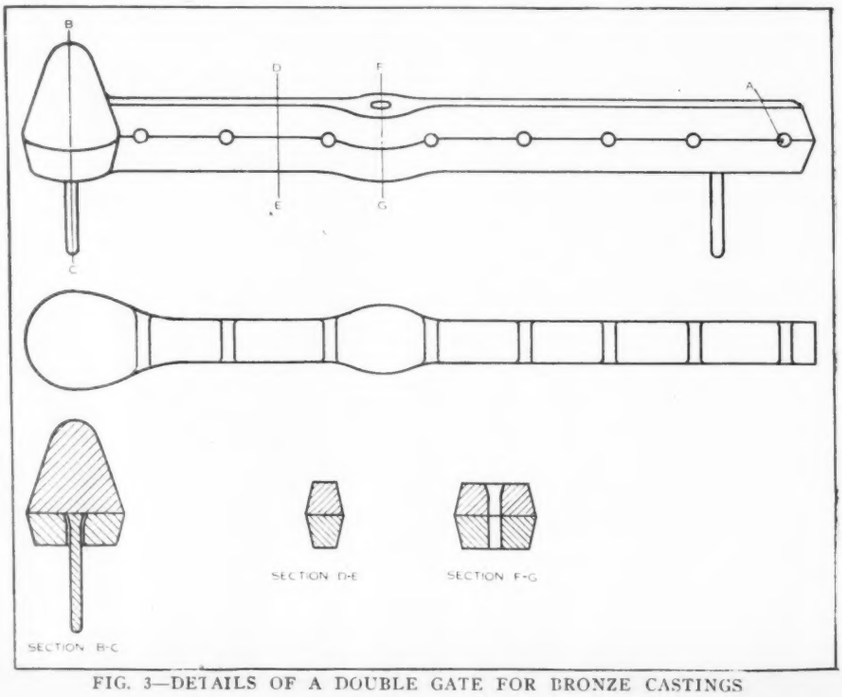


FIG. 3—DETAILS OF A DOUBLE GATE FOR BRONZE CASTINGS

be absolutely clean, as no dirt can be left for the *hungry* metal to take care of, as is frequently the case with iron. When careful methods of molding are abandoned and quality is sacrificed to quantity, it must be expected that the percentage of loss from defective castings will be high. In this case it would be well to figure whether a little less speed and hustle would not be more economical in the end, as every time the metal is melted it shrinks in weight and this loss would be remarkably low at 1 per cent.

Design of the Runner

To return to the construction of the runner; it is symmetrically enlarged at the center of gravity of its length to provide for the draw hole. Gates for brass castings receive very little rapping, the hole being used principally as a means of drawing the pattern. It is located, therefore, a little off center of the length of the runner towards the heavy end, so that the pattern will balance and draw, without tearing away one end of the mold. The round branch gates are connected to the patterns, by being inserted into holes drilled through sideways, at the juncture of the two runners. To facilitate the drilling of these holes, the two runners either are sweated together or are attached by screws, and the branch gates are bent to the required curve after being soldered in place. Different methods of assembling the gate prevail; in some cases the runner is assembled with its branch gates and the whole is solidly united before the patterns are attached, and sometimes the patterns are first attached to the branch gates and the runner is assembled afterward. The patterns are fastened to the gates by means of deep holes into which the gates are inserted and attached by solder, or the patterns are both tapped and soldered.

The steady pins are usually attached to the lower runner before the gate is assembled, although this is immaterial. The pins should be made of heavy wire that will not bend under the rough usage to which they are necessarily subjected. While the percentage of gates to castings is increased by the use of the double runner, this is compensated for by the increased number of perfect castings that are obtained with almost any class of work. Thin castings, not at all liable to shrink, are benefited by its use, as they run with greater certainty, the choking of the runner not being liable to occur.

Many other advantages of the double runner might be cited, but the most important are avoidance of shrink depressions in the castings and draw holes at the gates. Even

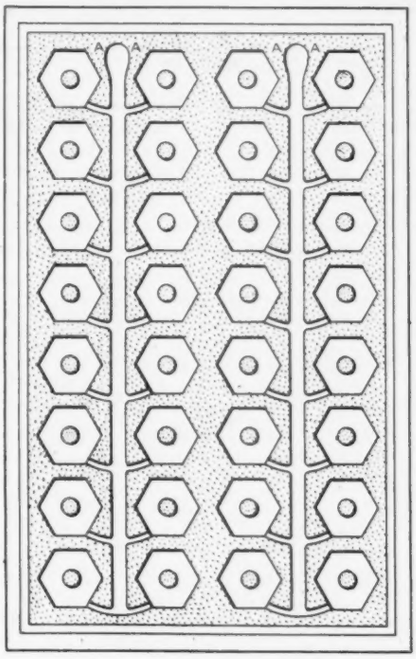


FIG. 4—ARRANGEMENT OF TWO GATES OF BRONZE NUTS IN ONE MOLD FRENCH METHOD OF POURING BRONZE CASTINGS

a gate of nuts, when gated as at the left of Fig. 2, and poured with metal at too low a temperature, will be found to shrink in the cope, and sometimes the depression will materially reduce the thickness of the nut if the latter is faced off until flat. In the case of the bushing, *F* and *G*, Fig. 1, this difficulty becomes more pronounced, and when gated as at *F*, hot metal is essential to avoid shrinkage on heavy parts, *D*. Notwithstanding these precautions, it is probable that the last molds poured will contain a large percentage of defective castings. The use of the double gate, as shown at *G*, Fig. 1, will obviate such difficulties entirely, and also another defect illustrated by the

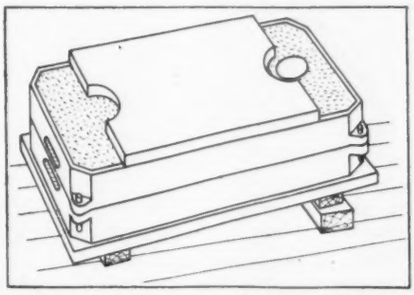


FIG. 5—A MOLD OF SMALL BRASS CASTINGS READY TO POUR

sectional drawing, *T*. This assumes the form of an elongated shrinkage cavity shown in the cored-out part of the casting at its juncture with the gate. This defect is traceable to the end gate with insufficient feeding power, and is entirely eliminated by the side gate shown at *G*, Fig. 1. If the gate at the left of Fig. 1 must be used, another runner should be molded on top of the gate, *AB*, forming a double runner, the sprue being located at *A*, and the mold inclined for pouring.

The dimensions of a gate of patterns is another important point for consideration when the patterns are being laid out, as the output of castings may be greatly decreased by gates designed without any knowledge of the size of flask in which they are to be molded. For instance, the two gates of nuts shown in Fig. 4, can be placed in one flask by economizing space in the manner indicated, but if they were spread out, as shown in Fig. 2, it is obvious that the output will be greatly decreased, as only one gate can be placed in a flask and that gate does not carry as many patterns as one of the twin gates shown in Fig. 4. There is no standard flask used in brass foundries, but the most convenient size, and the one most generally used, is 12 x 18 inches outside. This leaves about 10½ inches for the total width of the two gates, if twin gates are used, The length of the gates will be influenced by the shape of the flask; if the latter is rectangular, as shown in Fig. 4, the gate may safely be made about 2 inches shorter than the overall length of the flask, but if the corners are cut off diagonally, as illustrated in Fig. 5, the gates may have to be proportionately shortened.

Brass Foundry Burns

The following notice has been posted in the foundry operated by C. Cowles & Co., New Haven, Conn.:

"When an employe is burned by molten brass, the wound should be washed with a warm solution of a mixture of 50 parts of water containing 2 per cent carbolic acid, and 50 parts of strong solution of sodium carbonate. After the pain has subsided, a bandage should be applied saturated with a mixture of 80 per cent of strong lime water and 20 per cent of boiled linseed oil. After the blister that forms has been broken or has been reduced, the burn should be dressed with hydrogen peroxide diluted with one-half water and the wound will heal rapidly. If the burn is serious, call a physician. Pending his arrival, apply the carbolic acid and soda solution to the burned parts as gently as possible and leave the rest of the treatment to the doctor."

Brass Foundry Difficulties

Solved by Experts

Porosity in Brass Castings

We make heavy bronze pipe, valves, flanges and other brass and bronze castings. Our mixture contains about 85 per cent of copper in the form of scrap wire, copper bottoms, and material of a similar character. We melt the copper first under a cover of charcoal and just before the metal is ready to remove from the fire, we add the necessary amounts of tin, lead and zinc, and also 2 per cent of 15 per cent phosphor- copper. In spite of these precautions, we have been troubled with porosity, existing as fine holes which are distributed throughout the castings, and as the pipes are used for conveying acids, a large proportion have to be discarded as they leak and cannot be used.

The porosity in this case is due to the presence of an excessive amount of oxide in the metal, which may have been introduced with the wire in the form of scale, or has been formed while it was melting. Wire that has been insulated is liable to cause trouble from porosity, because in burning off the insulation, the wire is oxidized, the oxide being in the form of a brittle scale that adheres more or less strongly to the wire. When this is charged into the pot it melts, and is absorbed by the metal, thus introducing a considerable amount of gas, some of which is liberated as the casting solidifies. If the wire is clean when received, the oxide is formed while it is being melted, and we advise the use of crucible rings to protect the metal that projects above the top of the crucible from the furnace gases. The addition of 2 per cent of phosphor-copper should produce sound castings, and will, if proper precautions are observed while the metal is being melted.

Difficulty in Casting German Silver

We are making German silver castings and experience considerable difficulty in getting them to run. What can we add to this metal to overcome this trouble?

The addition of a small amount of aluminum, about one ounce to 100 pounds, will be found to improve the sand casting qualities of German silver and is frequently used for this purpose when making castings of light section. The use of aluminum, however, is not advisable when the castings are required to withstand pressure, as it will cause leakage, and it is doubtful if anything can be added that will materially improve the casting qualities of the alloy in this case. If the difficulty takes the form of porosity, the addition of ¼ of 1 per cent of 30 per cent manganese-copper will be found to be of material benefit, in fact, the use of manganese-copper in German silver is advisable in all cases.

German Silver for Valves

Please publish a German silver alloy that can be used for soda water fountain valves and similar castings. The metal must be close-grained and not too expensive.

We suggest a trial of the following alloy: Copper, 55 pounds; nickel, 15 pounds; zinc, 30 pounds, and aluminum, 2 ounces. Melt the nickel and the copper together, add the aluminum followed by the zinc.

Castings of Rich Color

Can you advise us how to obtain a fairly uniform and satisfactory color on red brass and steam brass mixtures? Will the addition of a small amount of aluminum result in a good rich color? We do not tumble our steam castings, but plunge them in water immediately after they are taken from the sand to remove the cores. The castings are not pickled as we desire to have them retain their natural color.

The essential requisites for the production of a rich color on red brass castings are clean metal, that is metal free from all iron contamination, and suitable mixtures. A mixture often used for valve bodies, consists of copper, 88 pounds; tin, 4 pounds; zinc, 6 pounds and lead, 2 pounds. Trolley wire, or any other clean scrap may be used in place of ingot copper, the chief essential being to exclude iron in any form. The addition of aluminum, even in minute quantities, will ruin the alloy, as the castings will run dirty, will shrink excessively, will leak and will come out of the sand a disagreeable whitish blue color. By all means exclude this metal from the alloys.

Gray and Yellow Spots in Bronze Fractures

The fracture of a 2-inch square section of phosphor bronze shows both gray and yellow spots. Is this characteristic of an alloy of copper, 86 per cent; tin, 12 per cent, and lead, 2 per cent? A phosphor bronze containing copper, 80 per cent; tin, 10 per cent; lead, 9.2 per cent; and phosphorus, 0.8 per cent, also shows the yellow spots in the fracture of a sand cast test bar. What is the cause thereof? What should be the color of the fracture of an alloy of copper, 88 per cent; tin, 10 per cent, and zinc, 2 per cent? Suppose the fracture of the metal has yellow spots and the rest of the metal is gray, does that signify anything? When should the zinc be added? When remelted and cast the same yellow spots in a gray background appear. If the alloy should have a uniform yellow fracture, what is the cause of the trouble?

Spots and discolorations of the recent fracture of an alloy usually indicate the presence of oxides in the metal that will seriously affect its physical properties, and in the case of phosphor bronze, may be taken as showing that something is radically wrong, either with the metal or the manner in which it is being melted. The 88-10-2 mixture ought to be free from yellow spots, but unless the metal has been deoxidized, its fracture is rarely perfectly clear. We suggest that you melt more carefully, and thoroughly stir the metal before pouring.

Plumbic Bronze

We would like to obtain some information regarding Plumbic bronze. We understand that this metal is a dual alloy of 50 per cent lead and 50 per cent copper. We have tried to make this alloy and can get a fairly good mechanical mixture of copper and lead, but are unable to obtain sound castings. We would like to know also, whether in using arsenic, there is any danger from the fumes.

Plumbic bronze is not a dual alloy of half lead and half copper. On the other hand it is a very complex alloy containing approximately 26 per cent of lead and is adapted for car journal

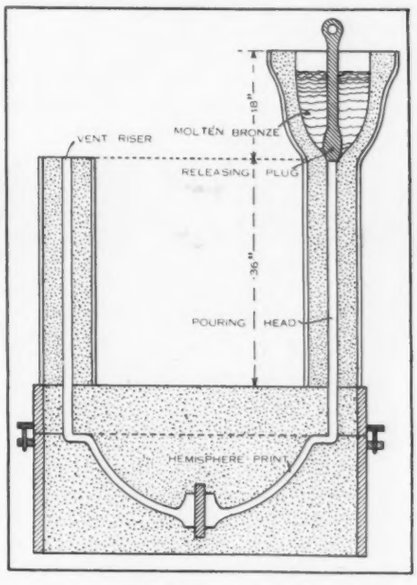
bearings. An alloy containing 50 per cent of lead would be too soft for this purpose. Bearings containing 40 per cent of lead are in use, but it is not advisable to use them under heavy cars, as they cannot be relied upon to carry the burden even when hardened with tin, nickel, iron or manganese. Journal bearings containing over 30 per cent of lead should only be used for the smaller sizes of bearings such as the 3¾ x 7-inch and 4¼ x 8-inch. The analysis of Plumbic bronze follows: Copper, 69.2 per cent; lead, 26.1 per cent; tin, 1.5 per cent; manganese, 1.7 per cent, and iron, 1.7 per cent.

The difficulty with the highly-leaded alloys is to prevent the liquation of the lead, and many and various are the methods employed to effect this desirable end. By the use of not more than 5 per cent of tin, lead up to 30 per cent of the mixture can be easily retained and fair castings can be produced. The use of more than 30 per cent of lead usually causes trouble and sulphur is employed frequently to prevent liquation. The same results can be obtained, however, by the use of suitable fluxes. If you have succeeded in obtaining a fairly good mechanical mixture, you should have no difficulty in making good castings. The use of arsenic is always attended with danger, but if it has to be used, be careful not to breathe the fumes.

Increase of Density in Pressure Casting

We are manufacturing an ice machine of French design, in which are used, bronze hemispherical bells 10, 15, 24 and 30 inches in diameter and varying from 35 to 350 pounds in weight. These hemispheres range from 3/16 to 1/4 inch in thickness, and are cast in France by the match mold process, in dry sand molds. To insure a very dense metal it is customary to carry up the riser and pouring sprue to a height ranging from 18 to 36 inches above the top of the flask. The metal is not poured directly into the mold, but into a large basin lined with refractory material, which is connected to the pouring sprue in the manner shown in the accompanying illustration. The metal is poured into this basin, which is of sufficient size to hold all the metal necessary to fill the mold when the basin is filled, a valve or plug in the bottom of the basin is raised, permitting the metal to drop down into the mold, filling it under a considerable pressure, due to the height of the head. A riser of the same height as the head is taken off the opposite side of the bell, substantially as shown in the illustration. The diameter of the sprue and riser is approximately 1 1/2 inches. We have attempted to do the work in this manner, but find it exceedingly inconvenient, as we have had no experience with pressure casting, we would like to have your opinion as to whether it can be dispensed with, and if so, what process could be employed that would insure the effect of casting in this way. The alloy used, follows: Copper, 88 per cent; tin, 10 per cent, and zinc, 2 per cent. It has been suggested that about 3 per cent of aluminum be added to improve the metal.

In what manner the application of hydrostatic pressure can affect the density of the metal in a casting, we fail to see, as this is influenced solely by the rate of cooling and not by the pressure of the head. Thus, a chilled casting is more dense in structure than



FRENCH METHOD OF POURING BRONZE CASTINGS

a sand casting, because it is cooled before crystallization and liquidation has set in. As no method has ever been devised for casting bronze in permanent molds or chills, discussion along this line would be fruitless, and attention will be drawn merely to the difference in density of two ingots, one cast in a sand and the other in an iron mold. This experiment is made easily and will prove the contention that the density of bronze is affected by the rate of cooling and not by hydrostatic pressure. It would make no difference what the pressure in the form of a high head might be put on the sand cast ingot, its structure would be crystalline and greatly inferior in density to that of the ingot cast in an open iron mold. It follows, therefore, that any molding medium that could be adopted in the case of bronze castings, that would promote rapid solidification of the metal, would produce castings more dense than is possible in sand molds. For this reason an investigation of the heat conducting qualities of various materials adaptable for making molds, such as carborundum and crushed granite, would be likely to be attended with greater success in increasing the density of the metal than the perfection of methods that would increase the hydrostatic pressure on the metal.

In the case of die castings, the pressure is applied to force the metal into the mold and to produce sharp, perfect castings, and does not of itself affect the structure of the metal. A certain amount of pressure is required for all castings, otherwise, and particularly in the case of bronze, the castings will shrink in places, or will fail to fill the mold. A casting of heavy section, run from the lowest point, will require a high cope and hot metal, to obtain castings without shrinkage on the back, provided it is not possible to obtain the same result by the application of risers on the highest point of the casting. In this case, however, the pressure and hot metal are similar in effect to the pressure applied to a die casting; they fill the mold, but have no effect on the density of the metal, as is shown by the fact that it is possible, and it occasionally happens, that the castings are porous, due to other causes, notably oxidation of the metal. In the case of the bell, if the mold is made as illustrated, and is poured in the manner indicated, with copper that has not been treated with some deoxidizing element, the castings will be porous and filled with holes, no matter how high the pouring head may be extended. The same result will follow the casting of bronze when improperly melted.

It is obvious that such a high head possesses no advantage to compensate for the unhandy method of working, and if in France, castings superior in density are obtained by this method, this is due to a better knowledge of pouring temperatures, gained by experience with these particular castings, and to more careful methods of melting.

The suggestion to use aluminum, we consider a very poor one, as its effect will be to produce leaky castings, instead of to prevent them, and, in addition, will greatly augment the difficulty of obtaining clean castings. We advise that care be taken to exclude aluminum, instead of adding it, and if a deoxidizer is found to be necessary, that phosphor tin be used, to the extent of 2 per cent, replacing that amount of ordinary tin.

The Dedication of the Martin Fox Memorial

Manufacturers and Their Employes Joined Hands to Pay Tribute to a Fearless Champion of Industrial Democracy

THE dedication and unveiling of the monument erected by the International Molders' Union of North America in memory of Martin Fox, president of that organization from 1890 to 1903, was held with appropriate ceremonies on July 5, in Calvary cemetery, Walnut Hills, Cincinnati. Addresses were made by Samuel Gompers, president of the American Federation of Labor, Frank Morrison, secretary of that same organization, Joseph F. Valentine, president of the International Molders' Union of North America, who also unveiled the monument; John P. Frey, editor of the *International Molders' Journal*, Cincinnati; Lazard Kahn, of Hamilton, O., member of the Stove Founders' National Defense Association, and Rev. M. A. Hamburger, pastor of St. Mark's Catholic church.

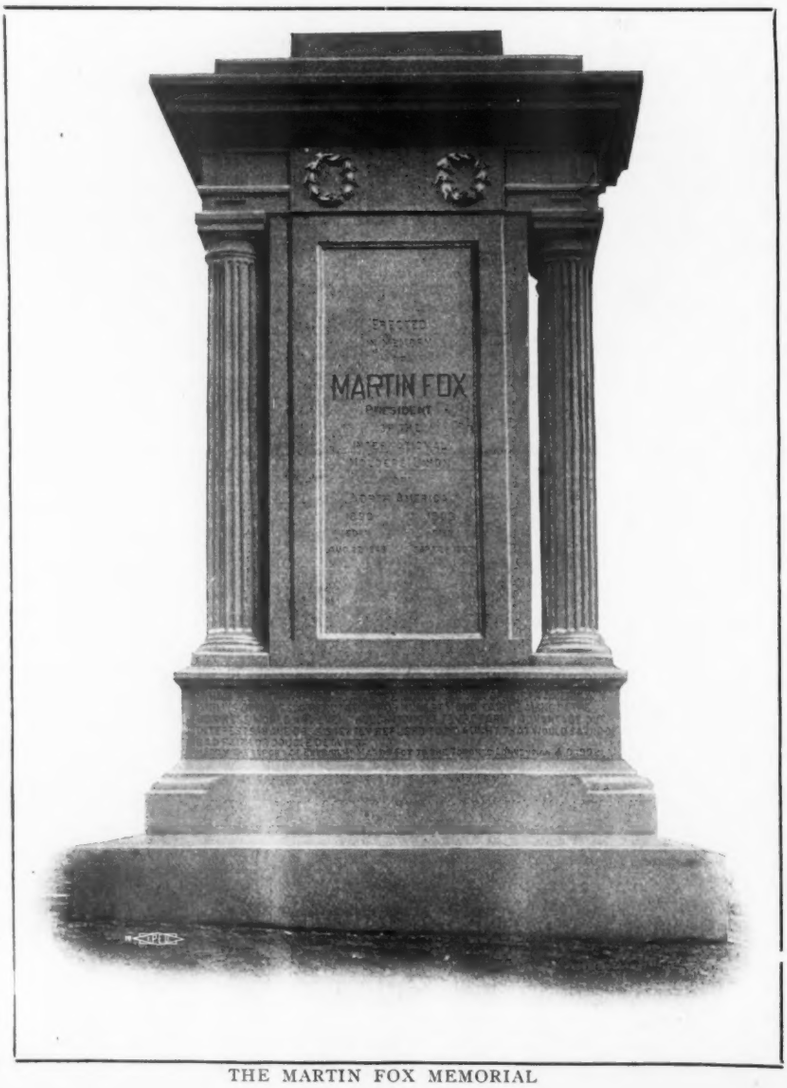
Martin Fox was born in 1848 and died in Cincinnati in 1907, being 59 years of age. He was known as a great organizer and for his fairness and honesty in all of his dealings. During his term of office as president of the International Molders' Union of North America he formed an agreement between that organization and the Stove Founders' National Defense Association, which at that time were having serious labor disputes, whereby all troubles between employer and employe were to be settled by means of arbitration and conciliation. It was the first of its kind ever adopted, and has been in successful operation for over 22 years.

Mr. Frey spoke as follows:

"Fifty-three years ago today a small band of practical and determined men representing 14 molders' unions, met in Philadelphia, within a stone's throw from where the Declaration of Independence was written and almost within the shadow of the famous building where the signers of that greatest of all human documents consecrated their fortunes and their lives to the cause of human liberty. These sturdy mechanics also drafted a Declaration of Independence and before their labors had ceased the International Molders' Union of North America had been organized for the purpose of guaranteeing industrial freedom and equality of rights for the molders of North America.

"For 53 years, this organization has consistently endeavored to apply the principles on which it was founded and to a marked extent it has succeeded in establishing equality of rights between its members and their employers. It has improved the conditions of labor for its members, it has given them a broader grasp of their rights and their duties towards their fellow men, it has elevated their standard of living to a higher plane, and it has earned a widespread reputation for fair and honorable dealing.

"There was a time in its history, however, when through errors in leadership, needless antagonisms had been created and a lack of confidence arose within its ranks. Its membership met with reverses and their number became reduced.



THE MARTIN FOX MEMORIAL

"At this time a young man who was to become the central figure of the reconstruction period, began to make his qualities of leadership apparent. In 1886, Martin Fox, who had already given evidence of exceptional ability as a member of the board of trustees, was elected as secretary of our organization. It was then that he took up his life work which was to have so marked an influence in shaping the policy of our organization and placing it upon a firmer foundation than it had ever rested upon before.

"When he entered upon his duties, he found the organization without strong central authority, its ranks weakened, its resources almost exhausted and little left but strong sentiments of loyalty to its principles on the part of those who had been fighting its battles and who, like Napoleon's Old

Guard, would surrender neither their principles nor their organization while life remained in them.

"On the outside, the organization was assailed by powerful employers who believed that their best interests could only be advanced by destroying what remained of the organization. It was at this critical period that Martin Fox inspired the members of our organization with renewed confidence and began to build up and strengthen its depleted ranks.

"As confidence increased and the organization grew in numbers through his devotion to its interests and his watchful care, another crisis arose, for the foundrymen in that branch of industry employing the largest number of our members at that time formed a powerful organization for the purpose of self-protection. Both organizations were called upon to prepare themselves for the struggle which seemed inevitable and when it came, both were better prepared to strive for mastery than they ever had been before.

"From that contest and the lessons which it taught, there developed a better understanding of the industrial problems and of the rights of those who were affected by them. At first there seemed to be no possibility of harmony between those who had so recently grasped at each others' throats in the strife and stress of industrial conflict, but the abler minds in both organizations believed that industrial warfare was unnecessary and that a temporary advantage gained by either side did not result in permanent benefit or in that only form of peace which can exist between men conscious of their rights and determined to defend them.

"Martin Fox was elected to the presidency of our organization in 1890, at a time when the strongest men on both sides were seeking a solution for the problems which had led to so much bitter strife in the stove industry.

"It was then and during this early period of his administration as president that Martin Fox gave evidence of his sterling qualities and remarkable ability as a leader. The great international union which he assisted in building up and placing upon a stable foundation will forever remain a monument to his successful life's work, but in the industrial world his best known and most far-reaching achievement was the part he took in the consummation and gradual development of that greatest of industrial contracts, the conference agreements between the Stove Founders' National Defense Association and the International Molders' Union. It was the first industrial agreement between a national association of employers and trade-unionists to be entered into since our modern industries began, and it has since become the standard by which all similar industrial agreements between employers and organized labor have been measured.

"When this agreement was entered into 22 years ago, there were many who looked upon it as a doubtful experiment doomed to failure and who would have been pleased to witness its destruction. There were many foundrymen who looked upon its provisions with antagonism and many trade-unionists who believed that it could not be of benefit to them.

"It was during this period of uncertainty when the newer, saner and more just methods of dealing with the problems which arose in the industrial field were being applied, that Martin Fox gave evidence of that sterling integrity of character, those high qualities of heart and mind and that unyielding devotion to principles which marked him as an exceptional leader and one of the greatest characters developed by the labor movement in the western hemisphere.

MARTIN FOX

"His administration convinced the foundrymen that it was possible to preserve industrial peace, and the relationship between the two associations, one composed of foundrymen and the other of union molders, became such that strikes and lock-outs were but a memory. Confidence replaced suspicion, and the methods of conciliation, regulated by mutually adopted rules, replaced the former resort to brute force in adjusting the points of difference which arose. A firm believer in conciliation and the spirit of arbitration, Martin Fox avoided recourse to strikes in the other branches of the foundry industry with all of his influence, but when peaceful measures failed, no one was more determined to fight the issue to a finish. While success did not always follow the molders' efforts to improve their condition, he never accepted discreditable peace, preferring instead temporary defeat.

"Upon the granite before us which marks the hallowed spot where those who loved and honored him returned his body to Mother Earth, there is engraved a statement from one of his official reports which testifies to his high ideals and straightforward purpose as a trade-union leader. The words are these, 'It has been my purpose to give the Molders' Union of North America and its officers a reputation for honesty and fair dealing in the business world, and even though it might temporarily advantage our interests, I have consistently refused to do aught that would savor of bad faith or double dealing.'

"Throughout the period of his administration, he labored to give our organization a reputation which would win the respect and confidence of those with whom it came in contact. By his example and counsel he taught our members to respect and obey their laws and impressed upon them the necessity of honoring the provisions of all agreements entered into with employers. In these efforts he was eminently successful and his administration was marked by splendid discipline on the members' part and by a continually growing respect among foundrymen for the value and desirability of agreements with the molders' union.

"In heart and mind, Martin Fox combined some of those rare qualities which make men true leaders of their fellow men. He inspired his associates by his example and his unselfish devotion to the cause to which he gave the best years of his life and the talents with which his Maker had endowed him. Modest and unassuming in character, never seeking the positions of honor and responsibility which were placed upon him by those he represented, kindly in spirit and bearing no resentment towards those who attacked his policies, placing loyalty to principle above all else, he was one of those characters who inspired his fellow men with a desire to strive for the right for the right's sake.

"Among the employers of labor he had earned a well merited reputation for honesty of purpose, steadfastness to principles, clearness of vision and

integrity of character. Through his personality, he won the confidence and good will of many foundrymen who found that through industrial agreements with the molders' union they could secure the most satisfactory method of adjusting those questions which continually arise between employers and employes.

"In the American trade-union movement, he was known as a fearless champion of human rights and industrial justice and one of the foremost advocates of the methods of conciliation and the spirit of arbitration for the solution and adjustment of industrial disputes.

"To the members of the International Molders' Union he was a trusted leader with a genuine interest in each member's welfare. To improve their conditions of labor and elevate their standard of living, he gave the loyal devotion of heart and mind for the best years of his life, and when health failed under the strain of long-continued labor, and he was no longer able to bear the heavy burden of responsibility, the members of our organization made generous provisions for his declining years.

"In the official family of the International Molders' Union, his kindly spirit and thoughtfulness for others won the deepest and most sincere sentiments of respect and friendship and at all times he enjoyed their loyal support.

"The tribute which we pay today but faintly expresses our respect for his memory and our appreciation for his great services to our organization and the trade-union movement. By his devotion to the cause of industrial justice and his masterful application of the principles of conciliation and arbitration to the adjustment of industrial disputes, through his integrity of character and his achievements as a leader of men, he gave the world a striking example of the measureless benefits which flow from the lives of those who devote their energies and talents to the uplifting of the masses who earn their bread by the sweat of their brow. He was a fearless champion of industrial democracy. He elevated himself by elevating his fellow men."

Time Lost Expressed in Dollars and Cents

The loss of time by employes at rates of wages varying from $1 to $3 per day, forms the basis of an interesting table which is being distributed by A. M. Thompson, 10156 Wallace street, Chicago, manufacturer of the Thompson adjustable malleable iron flask clamp, which is reproduced elsewhere on this page, shows the money loss to a firm by employes who waste five minutes per day. This loss probably can be considered the minimum in every shop or plant, and from data compiled and available, such losses average many hours per day when spread over a large number of employes.

TABLE SHOWING LOSS IN DOLLARS AND CENTS, RESULTING FROM THE LOSS OF FIVE MINUTES PER DAY FOR 1 TO 100 EMPLOYES DURING A PERIOD OF ONE YEAR.

Rate of wages, per day.	Money Loss in One Year, Through Loss of 5 Minutes Per Day. By 1	By 10	By 20	By 25	By 35	By 40	By 50	By 100
$1.00	$2.90	$29.00	$58.00	$72.50	$101.50	$116.00	$145.00	$290.00
1.25	3.62	36.20	72.40	90.50	126.70	144.80	181.00	580.00
1.50	4.35	43.50	87.00	108.75	152.25	174.00	217.50	435.00
2.00	5.80	58.00	116.00	145.00	203.00	232.00	290.00	362.00
2.50	7.25	72.50	145.00	181.25	253.75	290.00	362.50	725.00
3.00	8.69	86.90	173.80	217.25	304.15	347.60	434.50	869.00

Slag Flowing from the Tap Hole

By W. J. Keep

Question:—We would like to know whether the continuous flowing of slag from the tap hole affects the quality of the iron. Our cupola tender advises us that if he allows the slag to accumulate in the bottom of the cupola it will choke the tuyeres, which are less than 10 inches above the sand bottom. Our cupola is charged as follows: Bed, 900 pounds of coal and 200 pounds of coke; 2,500 pounds of iron is charged on the bed. The subsequent charges consist of 200 pounds of coke and 2,200 pounds of iron, and we melt at the rate of 10,000 pounds per hour. Our melting ratio is 1 to 5.5 for a 5-ton heat, divided into five charges. The blast pressure is 11 ounces. Our castings are extremely light and our iron should be very hot and fluid.

Answer:—The quality of iron is not influenced by the continuous flow of slag, but this is considered very poor cupola practice. The tap hole should be stopped at the first appearance of slag. It might be advisable to make the tap hole smaller. The melted iron should be 5 or 6 inches deep in the bottom of the cupola, and if the tap hole were exactly the right size, the iron would strike a balance at the right height. If the cupola melts faster and the iron reaches a higher level, the head of iron will cause it to run faster and if the melting is slower, the head of iron will be less and the stream smaller. It seems impractical in most shops to keep a continuous stream of iron flowing without slag and, therefore, stop-up at the first appearance of slag and open the tap hole before the iron reaches the tuyeres. The blast will prevent the slag from entering the tuyere openings. If the melter is afraid of the results of slag a slag hole can be provided.

While you do not give the inside diameter of your cupola, it seems as if the bed is too large. It is inadvisable to have slag flow from the tap hole and none whatever should be permitted to flow into the ladles. If the cupola tender is determined to let the iron run continuously he should arrange a dam and skimmer in the spout so that the slag will run over the side and the iron will run clean into the ladles. An article on the disposition of slag was published in the April issue of THE FOUNDRY.

Selecting Mixtures of Iron

One of the subjects presented for discussion at a recent meeting of the Lancashire Branch of the British Foundrymen's Association was "The Selection of Irons for Special Castings." The discussion was opened by Mr. Cordingly, who presented the following analyses of irons for consideration:

	A	B	C	D
Graphitic carbon ..	2.5	2.6	2.9	3.93
Combined carbon ..	0.5	0.6	0.53	0.25
Silicon	1.8	1.4	2.83	2.85
Sulphur .....0.8 to 0.15	0.8	0.075		trace
Phosphorus . ....0.5 to 0.75	0.56	0.996		0.911
Manganese	0.7	0.84	0.656	1.08

These analyses, the speaker stated, he had found very useful in determining mixtures, and instanced the case of a casting for a tank, 4 feet 6 inches square by 2 feet 6 inches in depth, and one-half inch in thickness, which cracked when first cast, the difficulty being overcome by the selection of analysis C, which gave an iron suitable for making such castings up to 12 feet square. The high silicon of this iron, he stated, tended to keep the iron fluid. For making cylinders, analysis A was suitable as the metal, being lower in silicon, had a closer grain, and the presence of the graphitic carbon made the iron sufficiently soft to machine well. Analysis C was also suitable, for cylinders, as was also D, the latter being especially adapted for castings that might be subjected to strains that might lead to cracking. When mixing by analysis it was possible to obtain exactly what was wanted, and in many cases good results could be attained by using cheaper irons.

Mining and Sorting Graphite in Far-Off India*

The Preparation and Shipment of Facing Material With Statistical Data Concerning This Important Industry

By Charles T Pettinos

GRAPHITE, also termed plumbago, black lead and silver lead, is pretty well distributed throughout the world, occurrences of it having been discovered in almost every country. The qualities of these occurrences are varied, some being highly valuable, while others are almost worthless. The application of this mineral, in the arts and commercially, is manifold.

The word graphite is from the Greek, and means to write. It was well known to ancient civilizations, pieces of it and various utensils marked with it having been found in ancient burial places. It is a curious fact that, while the mineral has been known for so long a time, its exact chemical nature was not recognized until the latter part of the eighteenth century. It was generally supposed to be metallic lead, and hence the name black lead. As late as the nineteenth century it was often called carburet of iron.

A German, Heinrich Pott, about 1750, was the first to prove that it contained no lead. Karl Scheele, 1742-1788, first recognized and established its true chemical nature, that is, carbon.

Graphite occurs in two distinct classes, crystalline and amorphous. The crystalline is in the form of scales or flakes, while the amorphous has more the appearance of a black or gray-black clay, having no structure or flake, although at times it has a semblance of structure similar to that of slate. The crystalline variety is used for such purposes as the manufacture of crucibles, lubricants, etc., although lead pencils are made from a high type of amorphous or semi-amorphous stock.

Occurrences of Graphite

All over the United States and Canada there are hundreds of occurrences of graphite, mainly in the form of a disseminated flake ore, seldom showing over 6 per cent graphitic carbon. The largest and richest of these areas are, the Buckingham district of Canada, the eastern Adirondack district of New York, Chester county, Pa., and Coosa county, Ala. The Canadian flake is usually heavier, thicker and more like certain varieties of Ceylon plumbago than is that of the United States deposits, the latter being best adapted for lubricating purposes. All of these deposits have produced very excellent crucible stock. The Adirondack ore probably carries a brighter and lighter flake than any other.

While mines and mills throughout these deposits have been worked periodically over many years, it has yet to be demonstrated that the refining of disseminated flake ore on this continent is profitable. This is principally because of the difficulty in separating the mineral from its gangue at a low enough cost, and especially when dealing with as low grade an ore as from 6 to 10 per cent.

Today there are more abandoned graphite mines and mills in the United States than there are in operation. In general, the cost of producing American flake graphite is so high and the price at which it is

*Read before the Newark Foundrymen's Association.

FIG. 1—ENTRANCE TO PETTINOS BROS.' PLUMBAGO COMPOUND, COLOMBO, CEYLON

sold so low, that even under the most economical conditions, the margin of profit is small.

In Mexico there are several large deposits of a very pure, soft amorphous graphite, which can be mined and finished for the market with little or no refining. This material is used principally in the manufacture of lead pencils and graphite paints, although considerable foundry facing is also made from it.

Bohemia and Bavaria

The deposits in Bohemia and Bavaria are found principally in a northeasterly direction from Passau, on the Danube, not far from the Austrian frontier. Both crystalline and amorphous and semi-amorphous graphite are found in lower Austria, northern Germany, Spain, France and Italy.

The oldest graphite mine in England is that of Borrowdale, in the county of Cumberland. It was discovered about 1540. The product taken out was so pure in its raw state that it was made into pencils by merely cutting it into strips and setting it in a wooden handle. So important was this mine at one time, that the English government prohibited the export of graphite, except in the form of lead pencils. The mine was worked only for a period of a few weeks each year, and finally became exhausted after being operated in this way for several hundred years.

berg, Germany. For many years the German graphite supplied pencil stock for the world, but today the bulk of it comes from Mexico, because of the greater purity and higher quality of the latter.

Siberia

The discoverer of the famous Alibert mine in Siberia was a French merchant, J. P. Alibert, who was exploring for gold in the vicinity of Irkutsk. In the mountainous region, about 650 miles from Irkutsk and close to the border of China, he found this large deposit of pure graphite. There is little information regarding the details of this mine, and, owing to its great inaccessibility, it was never worked very extensively.

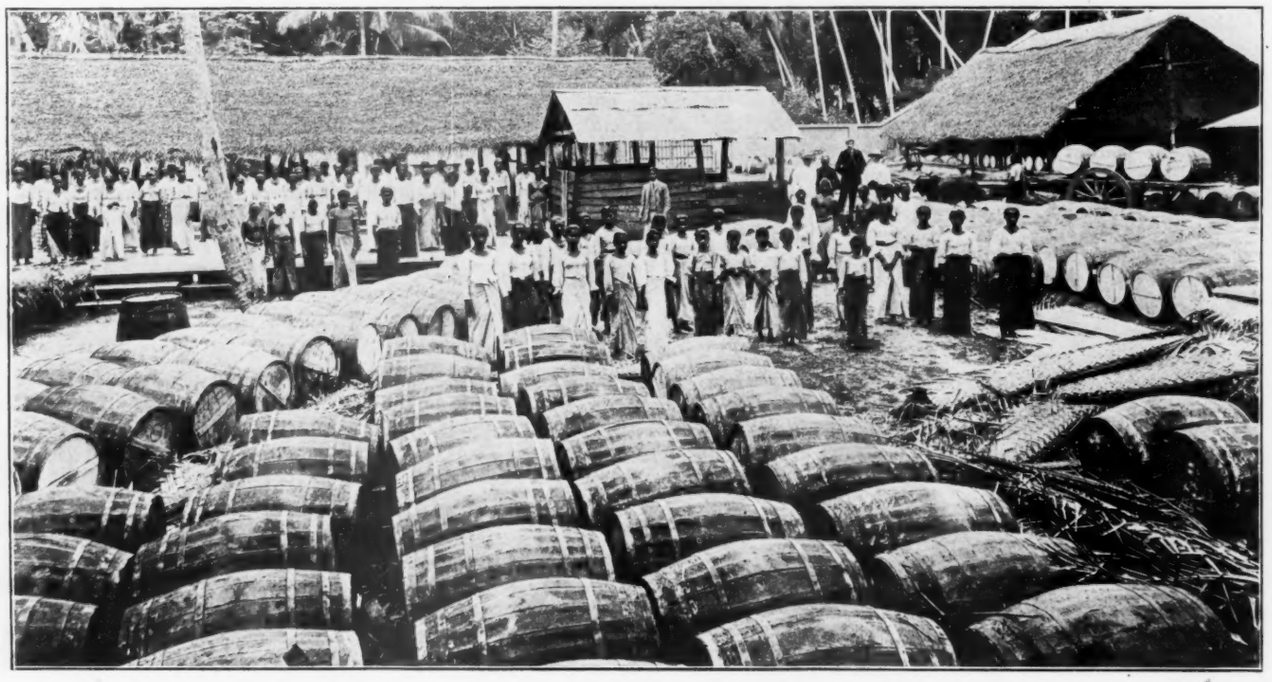


FIG. 2—CEYLON PLUMBAGO READY FOR SHIPMENT

amorphous graphites are in evidence. The crystalline, when refined, is used principally for crucible manufacture and the amorphous for lead pencil manufacture. The largest and most extensively worked mine of this district is that owned by the Count of Schwarzenberg, which was opened up in 1790. As much as 12,000 tons of finished graphite has been produced during one year from this property, which has employed as many as 700 people. Near Loosdorf, not far from the Danube, the writer has seen a series of pockets of semi-amorphous ore scattered over an area of several miles in extent, the ore showing as high as 60 per cent graphitic carbon. The nature of the graphite in the ore, however, renders it quite difficult to separate. Smaller deposits of

It has been reported that the graphite sold as high as 30 to 40 shillings per pound, and some of it sold for as much as £7 per pound. Eventually, the quality deteriorated to such an extent that a grinding and refining process was necessary, the concentrate being afterwards pressed into cakes and then cut into strips. Great difficulty was experienced in doing this because of the slippery nature of the mineral, until Hardmuth, of Vienna, 1795, discovered that a clay binder would overcome this difficulty, and this was the real start of the lead pencil industry. In the meantime, rich amorphous and semi-amorphous ores were discovered in Germany, and soon the center of the lead pencil industry moved from England and was established in Nurem-

We do know, however, that Alibert made a contract with a famous pencil maker, A. F. Faber, of Nuremberg, in 1856 for the total output of the mine, and received as high as $415 per hundredweight for some of this product.

Ceylon

The island of Ceylon, lying off the southern coast of India, is the most important graphite producer in the world. Ceylon furnishes 29 per cent of the world's tonnage and 80 per cent of its value. As high as 30,000 tons have been exported in one year. The graphite deposits, which are a series of pockets, extend along the western and southern side of the island, the mineral area being about 95 miles long, north and south, with

a width of about 40 miles, east and west.

The best graphite is found in rock formation, the principal districts being the Kurunegala, Ragedera, Ratnapura and Kegalla. Veins run in thickness from a few inches to 8 feet. A 4-inch vein is considered workable.

There are about 300 mines and quarries in active operation on the island, employing some 10,000 people of the two native tribes, Singalese and Tamils, the former being employed almost exclusively in the graphite operations.

Mining is carried on either in vertical shafts or in open cuts, the work being about as primitive as can be imagined, but, on the other hand, it is very effective and cheap, because the native labor costs only a few pennies per day. Men earn from 16 to 24 cents per day, and women from 6 to 12 cents. At the same time, these women and girls become very expert, and it is necessary to steadily employ a certain number of them in order to hold a nucleus of skilled operators.

Curing Graphite

The mineral is first given a preliminary picking or sorting at the pits, and is called uncured stock. It is then taken to Colombo and sold to what are known as curers. This curing is done in a compound, which is the general term in the far east for a fenced enclosure containing buildings. These compounds are sometimes several acres in extent and include a number of warehouses, curing sheds, etc. The curing sheds are merely cement floors with thatched roofs over them, and are called barbecues. Here the uncured plumbago is handled by the women and girls, sized, cobbed, washed and sorted by hand into certain well defined sizes known as large lump, ordinary lump, chip, dust and flying dust. As a rule, the lump is the most valuable, the chip next, etc. However, structure enters in to a great extent, and a stringy, flaky lump is more valuable than a short structure, dull, hard lump, even though the latter shows more graphitic carbon, or, in other words, more purity. A 90 per cent flaky lump is more valuable than a 95 per cent earthy lump. Also, certain high-grade chips are more valuable than some low-grade lumps. These comparisons in value extend through all the grades.

In the case of lump, each piece is handled by many hands, being rubbed and polished with gunny sack to improve its appearance. As impurities are almost always intimately associated with graphites, the large pieces are cracked open to guard against hidden impurities. Qualities from best to worst are classified as follows: X, X-B, Good B, B, BE and P. Under certain market conditions, prices rule as high as 1,000 rupees per ton for X and X-B ordinary lump. A rupee is about one-third of a dollar.

It is seldom that any large lot, varying from 25 to 50 tons, of Ceylon plumbago is received from any one mine, as the final product is almost invariably the result of a system of blending, in order to strike certain marketable standards. A parcel of 100 barrels of ordinary lump might represent stock coming from half a dozen different mines. This system of blending is very unique, and, at the same time, quite accurate. Most of the Ceylon plumbago is shipped from the seaport town of Colombo to various European and English ports and to New York. America takes more than any other single country, England ranking next, with Germany third. In 1911, the quantity of graphite from all sources imported into the United States for consumption was 20,702 short tons, valued at $1,495,729. In contrast to this, the total domestic production of natural graphite was 3,618 short tons, valued at $288,465. In the far east, graphite is also found in India, New South Wales, Queensland and Korea.

FIG. 3—NATIVES MAKING PLUMBAGO BARRELS AT COLOMBO, CEYLON

The existence of large graphite deposits in Korea has long been known, but no attempt has been made to develop them until within the last few years. The quality is almost entirely amorphous, although there are indications of crystalline graphite also. The amorphous in the raw ore is almost, if not quite, as pure as the raw Mexican ore, but differs from the latter in being darker, and having less the semblance of structure. It, furthermore, will not stand quite as high a fire test. The bulk of the deposits are in southeastern Korea,

principally in the Chosen district. In 1909 there were five producing mines in Chosen, all operated by Japanese firms. Since then others have been opened up. During the last two or three years from 5,000 to 8,000 tons per year have been exported from Korea to the Continent, England and America.

The manufacture electrically of artificial graphite at Niagara Falls has in recent years developed into an important industry. During 1911, 5,072 short tons were manufactured, which shows a large excess over America's natural production during the same period, of 3,618 short tons. This artificial graphite is used principally for electrical purposes and for graphite paints. Being amorphous in structure, it has not so far been used for crucible purposes.

The theory of the formation of graphite is vague, but the general opinion is that it is from carbonaceous matter originally present in organic form. It has often been claimed by scientists that beds of coal have been converted by nature into graphite, and especially into amorphous graphite, instances being pointed out in Rhode Island and in Sonora, Mex.

As has already been stated, nothing but the best grades of foliated or crystalline graphite can be used for the manufacture of crucibles. The same applies also to the manufacture of lubricants, although in recent years some high-grade amorphous graphite also has been employed for this purpose.

Table II.

Manufactures.	Per cent.
Refractory articles as crucibles, stoppers, nozzles, etc.	35
Stove polish	30
Lubricating graphite	10
Foundry facings	8
Graphite greases	6
Pencil lead	4
Graphite packing	3
Graphite paint	3
Electrotyping and miscellaneous	1
	100

Table I.

Exports of Graphite From Ceylon, in Short Tons, for the Years 1885, 1902 and 1911.

Destination.	1885.	1902.	1911.
Great Britain	7,670	7,586	5 794
United States	3.074	15,244	12,062
Germany	67	3,833	8,572
Belgium	.....	1,096	3,108
Other countries	187	453	695
Total.	10,998	28,212	30,231

Chemical analysis, as a rule, must be secondary to physical test in determining graphitic values. This is especially so in connection with crucibles. A dull, earthy graphite, showing 95 per cent carbon, certainly would not make as good a crucible as a flaky, stringy, brilliant graphite showing 90 per cent carbon, the fire test of the latter being higher than that of the former. The flake also seems to form a sort of skeleton, which imparts to the clay a high degree of solidity and of elasticity, as the graphite scales or flakes slip easily on each other along their planes, rendering pots made in this way highly resistant to sudden changes in temperature.

The first crucibles were made in the beginning of the fifteenth century near Passau, in Austria, and were used for melting precious metals. At present there are about 30 crucible factories in all parts of the world.

The manufacture of graphite lubricants is very extensive, crystalline graphite being employed principally for this purpose. The dry flake itself is used, and also in combination with oils and greases for various lubricating requirements. The graphite forms a thin, smooth coating to a bearing or journal, minimizing friction and remaining long after the oil or grease has disappeared.

The principal ingredient of stove polish is graphite, and it is surprising the large amount of the mineral that is required for this industry.

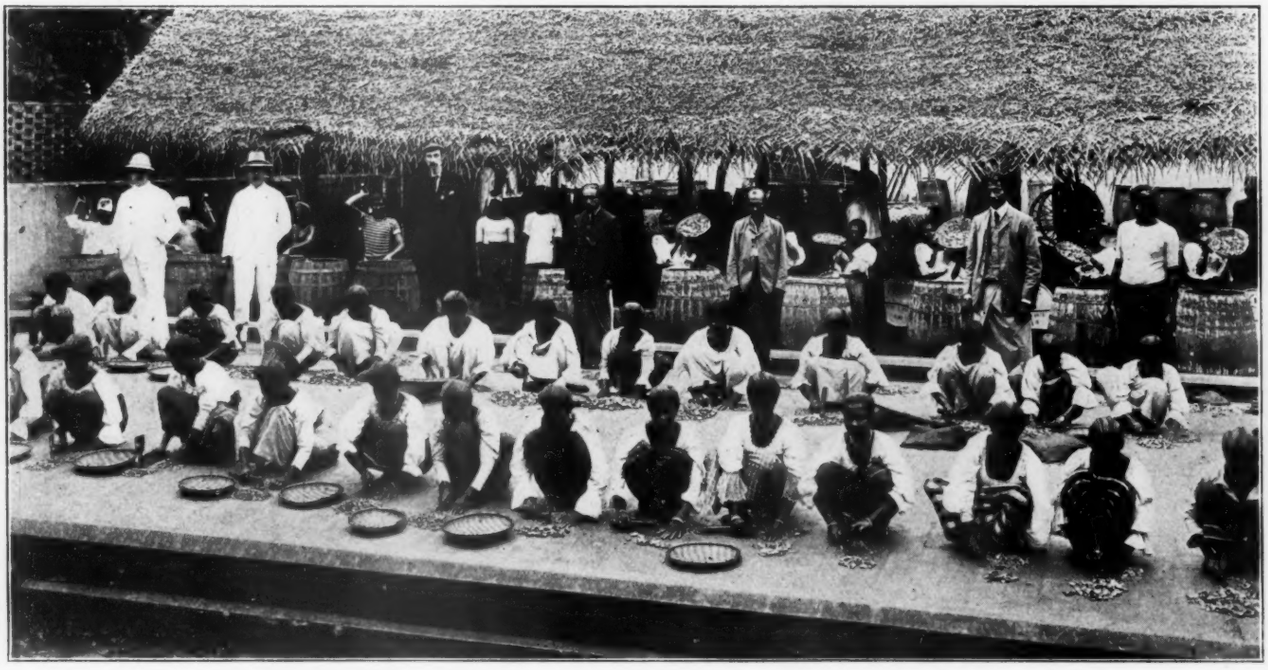


FIG. 4—PLUMBAGO CURING SHED, COLOMBO, CEYLON

Table III.

The World's Production of Graphite (Exclusive of Korea), for the Years 1907-1909, in Short Tons.

Country.	1907.	1908.	1909.
United States	29,277	2,587	8,243
Austria	53,013	48.970	44,875
Canada	579	251	863
Ceylon	36,406	28,916	36,056
France	138	.....	.....
Germany	4,409	5 340	7,467
India	2,725	3,218	3,508
Italy	12,125	14,235	12,768
Japan	115	195	136
Mexico	3.530	1,742	1,878
Norway	1,543	1,192	.....
Sweden	36	73	29
Queensland	34	22	.....
Total.	143,930	106.741	115,823

In Georgia a large amount of a low grade graphitic shale has been used in connection with the manufacture of fertilizers. This material has not been included in the totals of graphite production, and, strictly speaking, cannot be termed a graphite.

As a rule, a good grade of Ceylon dust is used, and especially in recent years, since what is known as paste polish has come into general use.

For foundry facings, both the crystalline and amorphous varieties are used, although it is universally conceded that a good quality of Ceylon dust plumbago gives the best result in foundry practice. It is often necessary to blend other minerals with graphite for facings, such as soapstone, coal, various clays, etc.

Graphite paint is very extensively produced by paint manufacturers all over the world, but principally in the United States. It has gained a foothold that is undoubtedly permanent. It is especially well adapted as a priming coat for structural iron and steel, as the mineral is inert, and is unaffected by climatic changes, acids or alkalies. Amorphous graphite is usually employed in the manufacture of graphite paint, as it admits of a finer pulverization than the crystalline type, and, therefore, will hold in suspension longer when mixed with oils.

Graphite is also used with the electrotyping process, for polishing powder, polishing shot, the dyeing of soft felt hats, the manufacture of steam packing and phonographs, and for boiler cleaning and pipe joint compounds. Table II gives estimated proportionate amounts of graphite used for different purposes.

Repairing the Cupola Lining

By W. J. Keep

Question:—At the end of each day's heat, the lining of our cupola is cut away approximately 5 or 6 inches in diameter for a height of 2 feet above the tuyeres. We melt from 30 to 40 per cent of steel scrap and the silicon of our mixture approximates 2.20 per cent. Our iron charges average about 1,600 pounds with a burden of 7 to 1. We melt 14 tons daily and our blast pressure is about 7 ounces. We would like to know whether the wear of the cupola lining is not excessive.

Answer:—You should use fire brick containing a higher percentage of silica or gannister containing a small amount of silicate of soda and water as a binder for patching the cupola. You undoubtedly are daubing your furnace and filling the burned-out sections with fire clay and lake sand. This patching probably is wet when the fire is lighted and cracks and falls off when dry. By all means use a brick for your lining containing a higher percentage of silica. When the lining burns away, insert new pieces of fire brick and cover all surfaces worn away not more ½ inch, with a daubing which contains a high percentage of gannister or ground fire brick. When the cupola is lined again, have it conform to the new shape it has assumed without alterating the diameter above the melting zone. The cupola then will hold more iron, will melt faster and the brick will not burn away as heretofore. Permit the slag to build out the lining slightly above the tuyeres for a distance of approximately 2 or 3 inches. This will deflect the blast to the center of the furnace. Use about 20 pounds of limestone for each ton of iron.

Alloy of Copper, Nickel and Iron

A new high tensile alloy, recently patented by G. H. Clamer, of Philadelphia, consists of copper and iron, alloyed through the medium of nickel. As is well known, copper and nickel, and nickel and iron form alloys without difficulty, and both nickel and iron unite with carbon. The new alloy contains from 25 to 50 per cent nickel, from 5 to 20 per cent copper and from 30 to 70 per cent iron, with the addition of a small percentage of carbon. The amount of the latter has to be so regulated that the copper will not separate in the form of nodules, 0.2 per cent being the maximum. The strength of the alloy can be regulated by the percentage of carbon present. An alloy consisting of iron, 65 per cent; nickel, 25 per cent; copper, 10 per cent, and carbon, 0.2 per cent, has the following physical properties: Tensile strength, 96,100 pounds per square inch; elastic limit, 51,750 pounds per square inch; elongation in 2 inches, 42 per cent, and reduction of area, 53.7 per cent.

The alloy may be smelted directly from the ore, or may be made by melting together the separate metals.

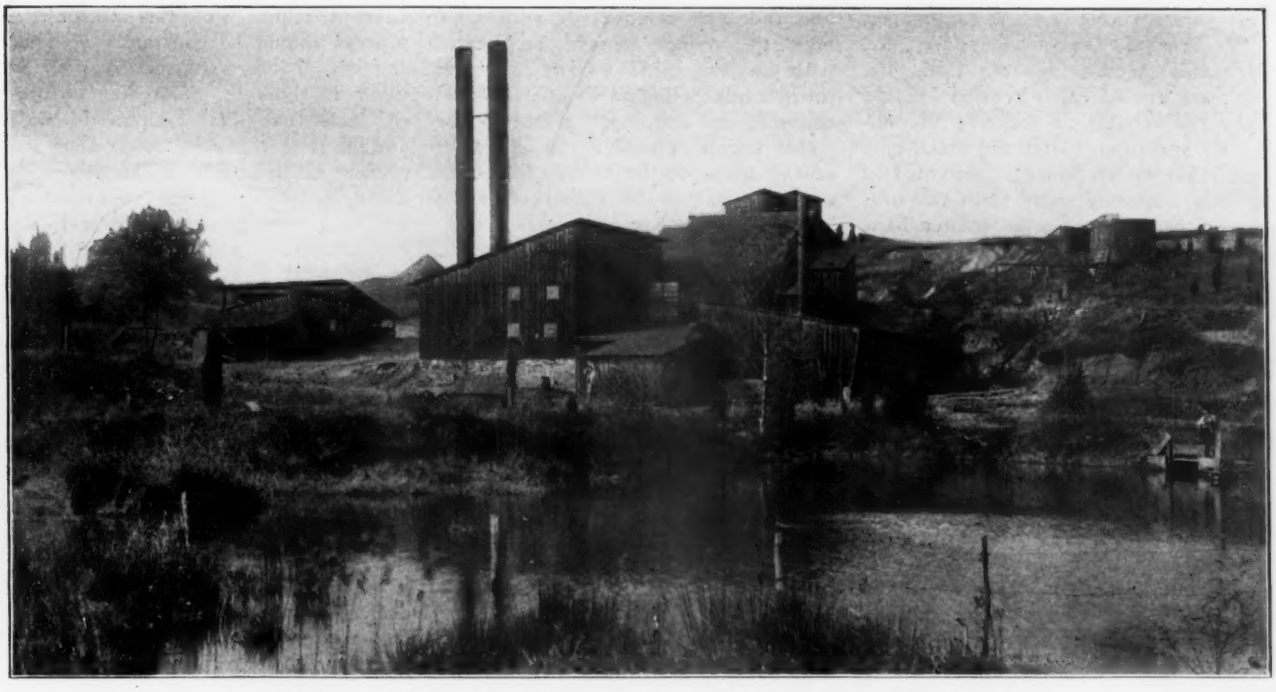


FIG. 5—GRAPHITE MINE AND MILL, BYERS, CHESTER COUNTY, PA.

Practical Hints for Practical Men

By Seymour W Rowsbar

THE metals best adapted to electro-silvering are brass, copper, bronze, German silver, etc. Britannia metal, pewter, lead, tin, etc., are not so easily treated because they are capable of resisting the finishing operation. Iron and steel, zinc and other metals must be regarded in a class distinctly apart from the others. Steel flatware with spelter handles was not long since a source of great annoyance to the plater and naturally he welcomed the abandonment of the combination. Whenever the metal to be plated is attacked by the cyanide bath so that silver is deposited by simple immersion and without the assistance of an electric current, it should receive a thin coating of copper or should be subjected to the process of quicking. The quicking operation is frequently performed even when the metal has no action on the bath in order to render adhesion doubly sure. The conscientious plater does not allow an element of risk to enter into his methods if any reasonable care can prevent. All iron metallic handles or parts should be removed from old goods if possible before plating and hollow sheet metal objects which have been filled with any composition to strengthen the metal should be thoroughly cleaned in order to eliminate any organic matter which might contaminate the bath and eventually cause more or less serious trouble.

Replating Ware

When old goods are to be replated, every trace of the old deposit should be removed in order that the new coating may be regular and adhesive on every part. Many platers experience difficulty in removing lacquer from articles to be refinished. The lacquers of today resist the effects of nearly all caustic solutions even when used at boiling point for several hours and in order to effect a rapid and thorough removal of such coatings, the objects should be treated with alcohol, which easily dissolves the hardest collodion lacquers. When choosing a stripping solution, the plater should consider the character of the metal to be removed as well as the metal to be refinished, as it is essential that the stripping solution is of such a nature as not to attack the basis metal to any appreciable extent while being deprived of the old coating. For German silver, copper and brass, a mixture of concentrated sulphuric acid and nitric acid is generally employed.

Acid Stripping Solution

When using acid stripping solutions, it should be remembered that any dilution of the solution increases the tendency to attack the metal beneath the coating. A very small amount of water is sufficient to cause violent action. For this reason the mixture should be kept closely covered when not in use, as both nitric and sulphuric acid absorb moisture from the air. Care also must be exercised when stripping not to introduce water with the objects. A very practical method of stripping silver, and one not as generally known as it should be, consists of heating a quantity of sulphuric acid in a crock and adding to it, just prior to use, a small quantity, approximately 4 ounces to each gallon, of Chilean saltpeter. This is at once decomposed and a small portion of the sulphuric acid neutralized, while an equal amount of nitric acid is liberated in the solution.

The mixture is used hot and is very rapid in its action. The silvered articles are suspended in the solution by copper hooks, and while no serious corrosive action should be noticeable, the solution is not to be trusted further than necessary to dissolve the silver coating. For this reason the process should be constantly watched and the articles removed as soon as silver is removed. Saltpeter is added each time the solution is used and in time the accumulation of potassium bisulphate from the decomposition of the saltpeter is evidenced by the deposition of crystals. It will also be noted that, when this condition is apparent, that the acid is neutralized to such an extent that the solution is not effective. A fresh solution should then be prepared while the silver may be recovered from the old dip. A cold solution naturally acts slower and consequently may be better controlled.

A mixture of 10 parts sulphuric acid and one part nitric acid, used at ordinary temperatures, gives excellent results and has the advantages of being capable of use on a larger quantity of work at one time than the saltpeter method. Pewter, Britannia metal, etc., may be economically stripped by the use of the electric current and a 10 per cent solution of potassium cyanide, reversing the current so as to make the object to be stripped the anode and employing a piece of brass or copper as the cathode, or an old silver solution may be used for the purpose, if no longer required as a silvering bath.

Faulty Connections

More platers experience trouble which is indirectly caused by faulty connections than from any other source. The following is an illustration of what frequently occurs and is given here trusting that it may reach the eye of some who may be lax in attention to these simple details. A foreman of 30 years' experience, being unable to overcome difficulties which were, to say the least, provoking, requested a younger man,

who had been quite successful, to come in and endeavor to locate the cause. After a few minutes investigation the tank connections were found to be poorly made and owing to neglect, the passage of the electric current was retarded. After cleaning and properly connecting the tanks, the results were quite satisfactory. The plater in charge admitted that he had such confidence in his ability that he became careless and when difficulties arose he overlooked the simple things. Another who had plated flatware for 20 years failed on 40 dozen knives in one day simply because he disregarded minor details.

Thin Coatings

The plater operating gold and silver solutions should be especially capable of producing results economically. While the thickness of the deposit may be governed by the class of goods being treated, carelessness in the preparation and finishing often entails unnecessary expense. White metal goods of the cheaper variety often receive a film so thin as to be useless to resist wear, the subsequent lacquer coating being depended upon to retain it in a salable condition for a limited period. A deposit of from 1 to 2 ounces per square foot of surface may be regarded a reasonably durable deposit and under ordinary conditions should wear from 5 to 10 years in constant use. The solvent action of many modern food preservatives found upon the family table and often left for hours upon silver cutlery and table ware is the cause of many cases of what might be termed premature decay of silver deposits. Modern silver cleaning preparations are compounded and offered for sale with utter disregard to the detrimental effects they produce upon the products of the electroplater's skill. These facts should cause us to make every effort to produce the best possible deposit. Even though your facilities are not up to date, try to do the work just a little better at least than some one else might do under same circumstances.

Occasionally the silver plater desires to make a copy in silver of a silver design, and many have experienced difficulty in securing a perfect reproduction. A simple method is to deposit a thin coat of copper upon the design and stop-off a line marking the copper edge as it would appear when design is covered by deposit of silver. After the resist is dry, deposit only sufficient silver to permit of careful removal. The resist is then removed from the copper line and the article is placed in a warm solution of perchloride of iron. It is allowed to remain in this solution until the copper has been removed or reduced to a spongy condition, when the copy may be raised, and if required of greater thickness, it may be protected on either side and again placed in the silver bath. Asphalt varnish is generally used as resist and benzole as the solvent.

When cheap articles of steel or iron are required to be silvered, they should be given a deposit of bright brass in preference to a copper deposit and the dip silvered. The results obtained by brass plating are far superior to the coppered article. When refinishing articles from which handles or other non-metallic parts are removed prior to the plating process it is often convenient to have handy a reliable cement with which they may be replaced. Equal parts of bath brick and rosin melted and mixed will be found to be a cheap and reliable adhesive and will resist cold and lukewarm water. Nickel and silver may be deposited from the same solution and the products of the bath equal pure silver. Make a cyanide of nickel by precipitating sulphate of nickel with cyanide, filter and wash. Add 1½ ounces of the cyanide of nickel and the same quantity of silver to a small quantity of cyanide. When completely dissolved add water to make one gallon. Use silver anodes and a slightly stronger current than is usual with silver solutions. An addition of cyanide of nickel will be required occasionally. The deposit is snowy white and resists the tarnishing effects of the atmosphere better than pure silver and an expert will be required to determine the difference. For many classes of work the deposit is superior to pure silver and costs less to produce. When precipitating the sulphate of nickel, proceed cautiously, as an excess of cyanide dissolves it. A deposit from a bath of this description, being harder than pure silver, should require considerably less time to produce an excellent, lasting coating.

Plating Difficulties

Solved by Experts

Finishing Steel Hooks

We are now finishing collar pad hooks by japanning them, but we would like to know whether any other method could be adopted which would resist corrosion to a greater extent than the japanned finish.

Before attempting to solve this problem, we investigated the condition of hooks now in use and after examining about 20 sets, we reached the conclusion that the success of any finish would depend entirely upon the rust-resisting properties of the finish. The use of any electro-chemical finish upon the hooks would prove useless if produced commercially, with the exception of one finish which was obtained by a 15-minute deposit in an acid copper bath followed by a nickel deposit in a barrel plating machine. The sample was then tumbled in leather meal.

The following method will produce the best results: Install an enameled iron or wood tank of sufficient size to accommodate the quantity of work you wish to finish daily and make a solution of the following: Concentrated phosphoric acid, 4 fluid ounces; fine iron filings, one ounce and one gallon water. The filings should consist of low carbon steel or wrought iron. The articles should be sand-blasted or tumbled in sand and water, after which they are rinsed and are placed in the boiling solution previously mentioned. Before being used, this solution should be boiled for a considerable period. Baskets or hangers may be employed to immerse the work. If baskets are used the hooks should be stirred occasionally by shaking the baskets. The hooks should be allowed to remain in the boiling solution from two to three hours and should be dried without rinsing by the use of a heater. Allow the solution to become concentrated to about one-sixth of its original volume. Any sediment remaining on the hooks after drying may be removed by tumbling them a few minutes in fine sawdust or leather meal. This would produce a rust-proof finish.

By using a colored celluloid enamel and applying it with a spraying machine, you can obtain any color desired and one coating produced in this manner will equal two coats of the best japan. Celluloid enamel is the latest development among the so-called lacquer finishes. By combining the rust-proofing process with the celluloid enamel finish you will obtain results which we believe you can equal in no other way. Zinc

is supposed to be an excellent protection for steel, but from our recent experiments we cannot advise its use for your purpose.

Another sample was finished by the Bontempi rust-proofing method. This was subjected to heat in a muffle and then a compound of chemicals was injected into the muffle creating fumes which filled the pores of the object and fixed a magnetic oxide of iron. The depth of the coating depends on the time of treatment. A coating 1/16 inch deep and even more is possible. This may later be plated, japanned or finished with celluloid enamel. None of these processes affects the temper of the hook.

Another sample was finished with one coating of undiluted japan baked at 300 degrees Fahr. for one hour. The edges of the sample were practically unprotected.

How to Prevent the Pitting of Nickel Deposits

How can I prevent the pitting of nickel deposits? I have used single nickel salts, also double nickel salts until the solution stands 9 degrees Baume and the pitting is worse than ever. I use a current of 3 volts tension and fill the baths with work to their full capacity.

Nearly every plater has ideas of his own in regard to the cause and prevention of pitting of nickel deposits. We will not attempt to treat the matter at any length, but simply give you our own method which invariably has been successful in this regard. Reduce the density of the nickel solution to 4½ or 5 degrees and add from 3 to 6 ounces boracic acid to each gallon; stir thoroughly, being reasonable in the use of current and you will obtain a deposit free from pits. The boracic acid should be dissolved in boiling water or a portion of the solution before adding it to the bath. To maintain freedom from pinholes, keep the solution clean and rinse the work well before placing it in the plating bath. Add a few pounds of single salts occasionally, but do not allow the solution to become too dense. By this do not infer that the bath be kept near the point of exhaustion. A slightly acid nickel bath, containing a proper content of metal, with a density of 4½ to 5 degrees, will produce better results for a longer period than a denser solution. Keep the solution free from the contaminating effects of dissolving metallic objects left in the bottom of the bath and keep the surface of the solution free from dust and dirt. Unless you are plating stove castings, we advise the use of a lower voltage and do not crowd the capacity of the bath, as nothing is gained by doing this.

Nickel-Plating Steel Strips

We are nickel-plating steel strips, 18 inches long. A deposit of uniform thickness is required. By testing them we find the strips hanging lowest in the solution have about the proper deposit while the upper portions are not heavy enough. Can you suggest some method by which we may be able to obtain a uniform thickness the entire length without turning the pieces?

With the anodes hung on the positive rod in the usual manner, the results you obtain are a natural consequence. A simple and very satisfactory method of arranging the anodes is to suspend every alternate anode by a hook of suitable size attached to the lower end. Anodes more than 3 inches wide will require two hooks. The hooks on the upper end are insulated by means of pieces of rubber tubing or may be thickly coated with asphaltum and serve only to retain the anode in upright position. By this method the upper end of every alternate anode acts the same as the lower end of the others and the deposit naturally is more uniform in thickness over the entire length of the piece of work being plated. The best results are obtained by using a narrow anode. Use iron wire of sufficient size to carry the necessary current. This method is applicable to any plating bath and is quite extensively used in nickel baths.

A Black Dip for Brass

I would like to receive some information, or a formula, for a black dip for brass which will give better results than the carbonate of copper and ammonia which I find unsatisfactory for continuous use in many lines of work. I also would like to receive information relative to producing a black surface upon steel, such as pliers, chisels, etc., which will resist oxidation.

The following solution will produce more uniform results on brass than the carbonate-ammonia dip and has the advantage of being much more agreeable to use. However, it requires the exercise of judgment in order to obtain the full benefits of its good qualities. Bring 3 gallons of water to the boiling point in a crock, as an iron pipe used for heating causes precipitation of the copper. Other means should be employed, or the pipe should be removed before adding chemicals. Add 2 pounds of German verdigris in powdered form to the water, stirring well for some minutes. If convenient, allow considerable time to elapse before making further additions. The verdigris can be powdered easily when ready to use. Next add about 1½ pounds of carbonate of soda while stirring and 1 pound of carbonate of ammonia. Then stir the solution thoroughly and add another pound of carbonate of ammonia, gradually, or enough to produce a clear solution. When the solution clears, cease adding ammonia. The carbonate of ammonia should be in crystal form and pure. In fact all the chemicals should be the best obtainable; some allowance will have to be made when making additions to the solution if they contain impurities. An excess of carbonate of ammonia will corrode the brass and will produce a greenish gray color. If such results are obtained, acid-dip the articles thus affected, and add more carbonate of soda to the solution. Carbonate of soda in excess will cause iridescent colors. This defect may be corrected by a small addition of carbonate of ammonia. For yellow brass, use the solution a little strong in soda and for red brass use an excess of ammonia. Make all additions cautiously and the solution will produce a fine black which, with reasonable use, will not require lacquering, but it is better to so protect it. Allow the work to remain in the solution from 45 seconds to 2½ minutes, depending on the condition of the solution and depth of color desired. A perfectly clean surface is required to receive the color. After a few trials you will find the bath works well. It can be maintained ready for use at any time, if merely heated.

To produce a non-oxidizable black coating on steel, proceed as follows: Dip the articles in a solution made by dissolving 1 ounce of chloride of bismuth; 2 ounces of bichloride of mercury; 1 ounce chloride of copper, and 6 ounces of hydrochloric acid in one gallon of water containing 5 ounces of denatured alcohol. Use the solution at about 80 degrees Fahr. and if one immersion does not produce the required color, redip the articles; when the color is obtained, place in clean, boiling water for a few minutes, then remove and dry.

The W. H. Stewart Mfg. Co., Brooklyn, N. Y., has been reorganized and the firm name has been changed to the Delevan Mfg. Co. Additional equipment has been installed for the manufacture of core compound, ready roofing, sheathing, liquid paints, etc. The officers of the reorganized company are as follows: A. R. Townsend, president, I. Singer, vice president; W. H. Stewart, secretary, and M. Meyerson, treasurer.

The Favorite Stove & Range Co.'s New Shop

WHEN the Favorite Stove & Range Co., Piqua, O., decided to increase its casting producing capacity by the erection of an additional foundry, it was concluded that the shop should be a model of its kind and one in which every foundry need would be scientifically provided for. A thorough investigation was made of the construction of foundry buildings and the structure with a wood, trussed roof, with its attendant high insurance rate was soon eliminated from the types under consideration. It was ascertained that the extra cost of a fireproof building would be compensated by its saving of insurance premiums, low cost of maintenance and lighting. It was shown, furthermore, that the direct savings that could be effected would more than pay the interest and provide a sinking fund for the excess cost of a well-lighted, fireproof shop. Yet the greatest advantage to be gained—increased efficiency of the employes—could not be figured in dollars and cents. With the preponderance of argument in its favor, it was decided to erect a building, fireproof throughout in the construction, of which only concrete, steel and glass would be used.

Ideal Shop Arrangement

The next problem considered was the arrangement of the shop as it was desired to lay out the foundry so as to enable the molders to attain their maximum efficiency, irrespective of the lighting and sanitary conveniences. Careful tests were made to

FIG. 1—GENERAL VIEW OF ONE OF THE MOLDING FLOORS OF THE FAVORITE STOVE & RANGE CO.'S NEW FOUNDRY. THE FLOOR IS ENTIRELY UNOBSTRUCTED

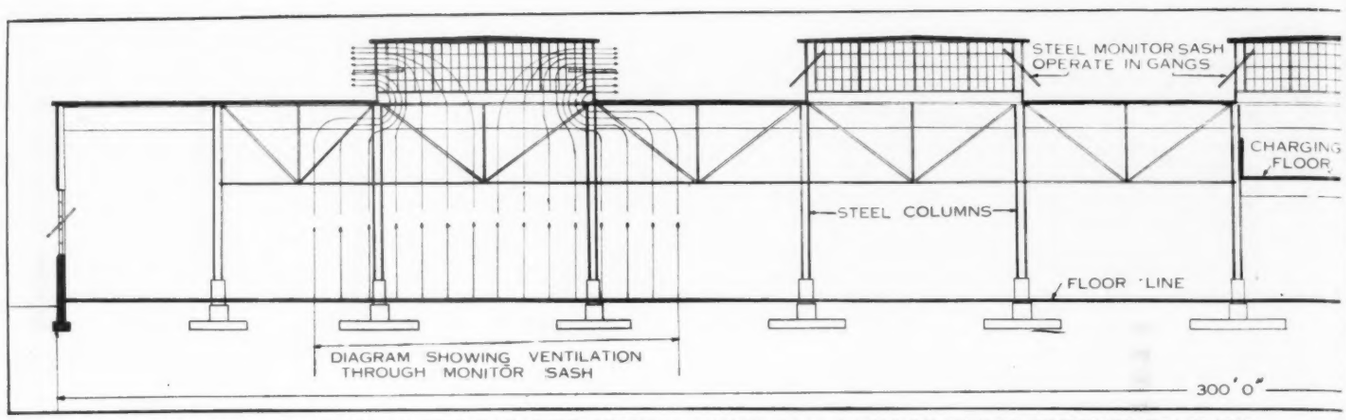


FIG. 2—LONGITUDINAL SECTION OF THE FAVORITE STOVE & RANGE CO.'S FOUNDRY WHICH INCLUDES DIAGRAMS

ascertain the amount of floor space which should be allotted to a molder engaged on such light work as stove plate and it was decided to make the floors 65 feet long and 10 feet, 8 inches wide. At the end of each floor a flask stacking space, 5 feet wide and 1 foot above the floor level, has been provided with a space 3 feet wide at the opposite end of the floor for piling castings.

Light and Ventilation

The building erected is 300 x 140 feet, the height of the main portion being 20 feet. On the roof there are five monitors, each 25 x 80 feet, and 8 feet high. To provide ample light and ventilation, the unique arrangement of monitors, illustrated in Fig. 2, was adopted. The floor space, adjacent to the four walls of the shop for a distance of 25 feet, is directly lighted from the outside windows and indirectly from the overhead monitors. The space under each monitor with the 12½-foot area surrounding it is lighted in all instances by the monitor itself. The effect of this arrangement is a uniformly lighted shop throughout the day, obviating the necessity of adding artificial illumination at pouring-off time.

The side wall ventilation provides a cross draft or feeding inlet of air close to the heads of the men. About 33 per cent of the side wall windows are so arranged that they can be opened and in the monitors the entire window space can be opened for ventilating the shop. The result attained by this arrangement is that the fresh air enters the building from the sides and the heated air in the shop rises into the monitor pockets and escapes through the monitor windows. As the roof of the shop is flat, the impure air cannot be held in pockets, but must pass out through the side windows in the monitors. On hot days and when pouring-off, the foundry is cool and there is an entire absence of smoke and steam.

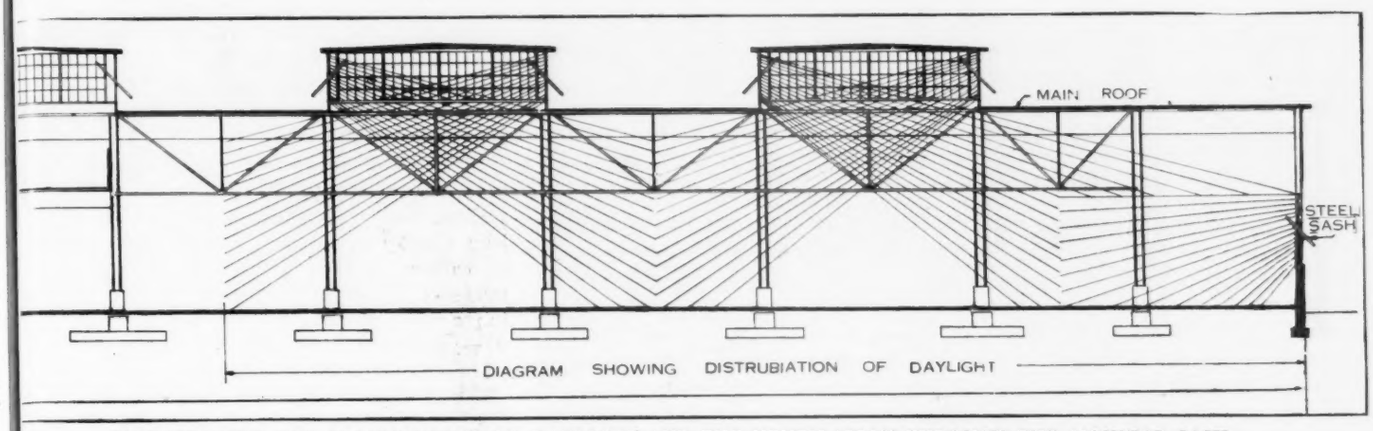
Extending a height of 5 feet above the floor, the wall of the building consists of concrete, 1 foot thick. Above this, for a height of 10 feet, there is a continuous row of steel sash windows installed by the Detroit Steel Products Co., Detroit, and above the windows there is a concrete curtain wall, 5 feet high, consisting of a 2½-inch slab of concrete applied to metal lath.

The framework is of steel construction, the roof being supported by trusses as shown in Fig. 7. The two rows of columns supporting the roof extend through the center of the shop, forming a gangway, 10 feet wide, for distributing the metal to the floors, as shown in Fig. 4. The molding floor area on either side of these columns is entirely unobstructed, as illustrated in Fig. 1. The roof consists of reinforced concrete slabs, 2 inches thick, arranged in 6-foot spans and resting on the steel framing members. The continuous steel sash windows in the monitors are 5 feet high and are equipped with the Drouve opening and closing device. The charging room floor, which is of steel construction throughout, is 25 x 80 feet, and is enclosed to a height of 4 feet. The foundry floor is concrete. The center columns are set on concrete footings extending 3 feet above the foundry floor. Each base is 2 feet square on top and rests on a slab of concrete, 6 feet square. To prevent the chipping of these footings, they are protected by cast iron sheathing, bolted together as shown at *A*, Fig. 1.

FIG. 3—ANOTHER VIEW OF THE FOUNDRY, SHOWING THE UNOBSTRUCTED FLOOR WITH THE CUPOLA IN THE BACKGROUND AT THE RIGHT AND THE BLOWER ROOM, *A*, AT THE LEFT

Melting Equipment

The iron is melted in the 84-inch cupola located at approximately the center of the shop and the floors at the extreme ends of the foundry are only 150 feet from the furnace. Owing to the convenient location of the cupola



ILLUSTRATING THE DISTRIBUTION OF DAYLIGHT AND THE VENTILATION THROUGH THE MONITOR SASH

and the comparatively short distance the iron has to be carried, it has not been considered necessary to install a tramrail system to convey the iron to the floors. The blast is furnished to the cupola by a positive pressure blower installed by the Piqua Blower Co., Piqua, O. The blower and motor are located in an enclosed room built of brick, as shown at *A*, Fig. 3. Air from the blower is transmitted from outside the foundry through 4½ x 1½-foot rectangular steel pipe attached to the wall of the blower room. This pipe connects with a tunnel, covered with cast iron plates, under the floor leading to the blower inlet. The blower is operated by a direct current, 50-horsepower, General Electric motor.

The molding machine equipment consists of one Pridmore roll-over machine for molding fire pots; two Modern machines and two squeezers of the Arcade type and two Tabor power squeezers.

Machine Apprentices

Apprentice molding machine operators, after serving three years on the machines, receive one year's experience at bench and floor work to round out their foundry training. This scheme has proved exceedingly helpful to the molding machine apprentices, as it gives them a grasp of foundry work which they otherwise could not obtain, particularly if their experience were limited to molding machine work.

Artificial illumination is provided by long flame 120-hour arc lamps. Only 16 lamps are required to light the shop and these are arranged diagonally over the floor, the radius of illumination of each lamp being approximately 40 feet. No lamps are located in the gangway and it has been found that by arranging the lights in this way excellent illumination is provided in the area where it is most required when pouring-off on dark days.

The cleaning department, which serves the company's two foundries, is located in a building adjoining the old shop. The casting cleaning capacity recently has been practically doubled and a large amount of new equipment has been installed. The tumbling barrels and the fans for the dust exhaust system are motor-driven. A section of the cleaning room is illustrated in Fig. 5, which shows one of the motors used for driving a battery of mills. It will be noted that the gears driving the main shaft are entirely enclosed to safeguard the employes from accidents. The cleaning equipment consists of 30 tumbling barrels driven by two 5-horsepower and two 7½-horsepower General Electric motors, and one sand blast installed by A. Jorn Jr., Waukegan, Ill. All of the mills are connected with a dust exhaust system, two dust arresters, together with the necessary fans and equipment having been installed. The fans, motors, etc., operating the dust exhaust system are located on a floor directly above the tumbling barrels, as illustrated in Fig. 6. In this view one of the steel plate dust arresters is shown in the background and the belt drive for the fans from the motors is clearly shown. The dust is discharged from the arresters into wagons. A creosoted wood block floor has been laid in the cleaning room and has given excellent service. Various types of floors were experimented with in this department and thus far the wood block floor shows practically no wear. The foundry was designed by Wm. E. Russ, architect, Dayton, O.

The Providence, R. I., office of the J. W. Paxson Co., Philadelphia, manufacturer of foundry supplies and equipment, is located at 741 Grosvenor building. W. Scott Thomas is manager of this branch.

FIG. 4—GANGWAY EXTENDING THROUGH THE CENTER OF THE FOUNDRY WITH THE MOLDING FLOORS ON EITHER SIDE

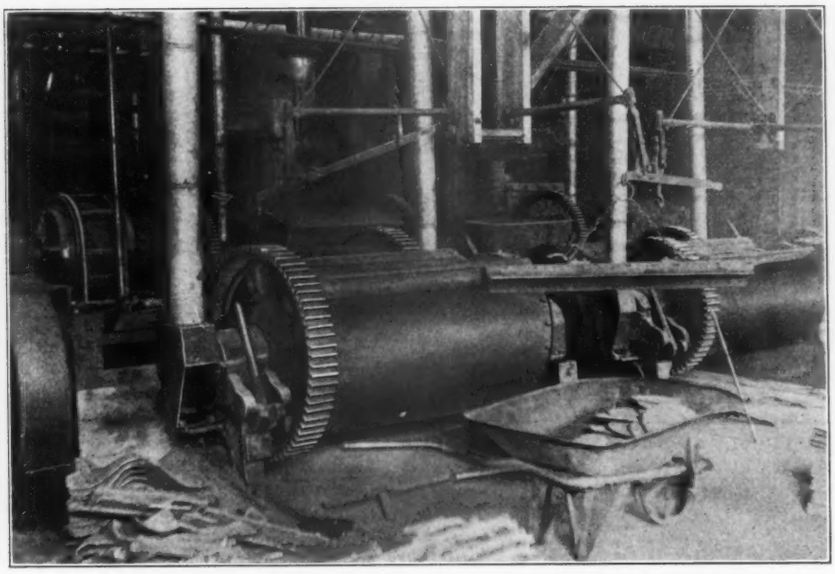


FIG. 5—A VIEW OF THE CLEANING ROOM, SHOWING THE MOTOR-DRIVEN TUMBLING MILLS

The Constitution of Cast Iron

In a paper read recently before the Birmingham, Eng., branch of the British Foundrymen's Association, W. H. Hatfield dealt with the constitution of cast iron and some of the changes produced by heat treatment. He remarked, in part, that the constitution of cast iron was more complicated than that of steel, owing to the presence of large quantities of other elements than iron and carbon, the principal constituents of steel. Cast iron contains manganese, sulphur, silicon, and phosphorus, all of which individually produce definite reactions with iron and each other, causing the iron to become a complex and variable mass of free iron and free carbide, sulphides, silicides, and phosphides. Each individual constituent possesses its own particular characteristic, its own thermal phenomena, and what is more important, its own co-efficient of contraction. One important aspect of the presence of impurities is that their actual influence is greater than would be anticipated, judging by analysis. Thus a cast iron containing from 6 to 7 per cent of impurities, actually contains from 30 to 40 per cent of the compounds formed therefrom.

Iron and Carbon

It has been clearly demonstrated that metals and alloys when freezing and cooling act similarly to aqueous solutions, and that in its solid state, cast iron can be considered as a frozen solution of carbon in iron. Its composition, is almost invariably the same as the eutectic alloy of the iron-carbon system which possessed the lowest melting point of the series. Iron will retain in solution, at the freezing temperature in the absence of other elements, 4.3 per cent of carbon, and the entire range of pig iron usually approximates 4 per cent of carbon, subject to the modifying influence of other elements. Silicon has a two-fold influence on cast iron; it materially affects the solubility of carbon and causes it to assume the graphitic state in the final pig or casting. Its influence on the solubility of carbon is clearly indicated by the following table, which summarizes the research conducted by Wust and Petersen:

No. of test.	Silicon, per cent.	Total carbon of eutectic, per cent.	Freezing point, degrees Cent.
1	0.13	4.29	1,138
2	0.21	4.23	1,131
3	0.66	4.05	1,152
4	1.14	3.96	1,155
5	1.41	3.88	1,160
6	2.07	3.79	1,175
7	2.68	3.56	1,185
8	3.25	3.41	1,187
9	3.69	3.32	1,197
10	3.96	3.24	1,205
11	4.86	3.08	1,210
12	5.06	2.86	1,215
13	13.54	1.94	1,233
14	18.76	1.19	1,240
15	26.93	0.87	1,255

This table shows that the eutectic alloy containing 4.3 per cent of carbon in the absence of silicon, is considerably modified at the usual content of 3 per cent of silicon, at which point the carbon percentage of the eutectic is reduced from 4.3 to 3.4 per cent.

Silicon in Cast Iron

The influence of silicon in the foundry is, however, greatly modified by the size of the casting, its rate of cooling and the casting temperature. The size of the casting is the paramount consideration, and other things being equal, will determine the rate of cooling, and slow cooling favors the precipitation of carbon. Concerning the influence of casting temperature, it has been clearly demonstrated that the higher this may be, the more combined carbon will the casting contain.

The effect of phosphorus is also to reduce the solubility of carbon, and irons very high in silicon and phosphorus generally are low in carbon. Phosphorus appears to have little influence upon the actual condition of the carbon, its chief advantage being to lower the melting point of the iron, a feature valuable in the production of small castings as it enables the metal to be melted at lower temperatures and with consequently lower coke consumption. It has been demonstrated

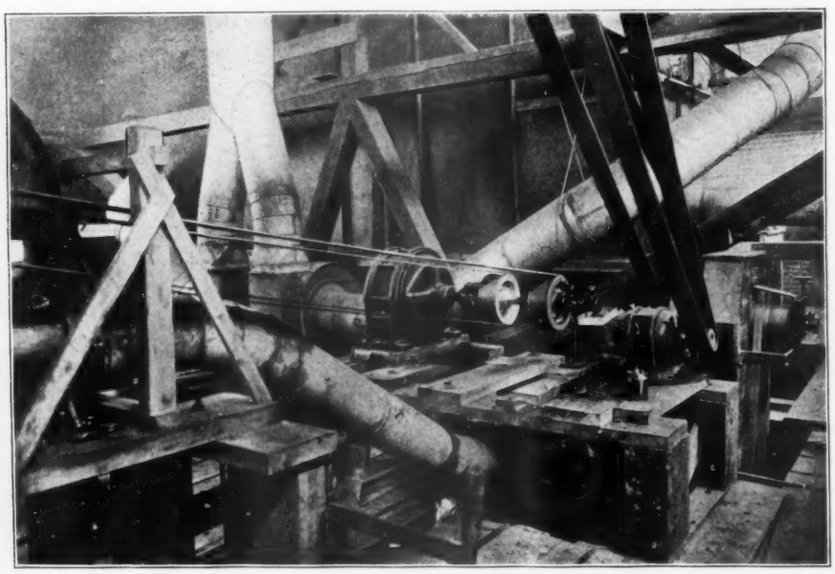


FIG. 6—EQUIPMENT OPERATING THE DUST EXHAUST SYSTEM

that the actual point of solidification of cast iron is lowered 27 degrees Cent. by each addition of 1 per cent of phosphorus, until 6.7 per cent is reached. Its disadvantage is that the irons are more brittle, and consequently less strong.

Sulphur

Sulphur in foundry irons usually exists as manganese sulphide, and as such practically may be ignored, as its action is neutral. Irons containing little or no manganese, are hardened by sulphur when present in considerable quantities, owing to the carbides persisting down to low temperatures. This action of sulphur in causing the carbon to remain in the combined state, although the subject of much experiment, has never been quite solved. It has been suggested that the sulphide films prevent the segregation of the carbide and render it stable, but it has been claimed also that sulphur is actually to be found in the carbide and that its action is of a chemical nature.

The effect of manganese is to neutralize the sulphur. When normal percentages, such as exist in the usual foundry irons are considered, the influence of manganese may be practically ignored.

With respect to the influence of special elements on cast iron, vanadium and chromium increase the hardness and strength. Aluminum and nickel soften the iron by assisting in the precipitation of free carbon, and titanium acts as a deoxidizer.

Heat Treatment of Cast Iron

Gray iron is subjected to heat treatment to relieve internal strains set up by the crystallization produced during the freezing of the iron and also to soften the casting by the decomposition of combined carbon. Annealing unavoidably weakens gray cast iron, as the metal consists of a matrix of ferrite or silico-ferrite, more or less strengthened by pearlite which is cut up and weakened by numerous graphitic plates, and the phosphide constituent which is usually present when the silicon content is low. A comparatively short exposure to heat, between 750 and 800 degrees Cent., is sufficient to completely soften foundry mixtures, by precipitating the combined carbon present. The tensile strength of such castings will be reduced by annealing, from a range of 20,000 to 35,000 pounds to 6,700 to 11,200 pounds, by breaking down the combined carbon. It will be noted, therefore, that while annealing softens the iron, its mechanical properties are materially weakened.

Heat Treatment of White Iron

The heat treatment of white cast iron, means practically the malleablizing process. White cast iron consists of cementite, carbide and pearlite. The object of the heat treatment is to decompose both the cementite and the pearlite, with the production of annealing carbon. If this operation is successfully conducted, a material is obtained consisting of ferrite, in which nodules of the free carbon can be observed. Such material compares favorably with wrought iron, and is extremely ductile.

In the ensuing discussion, A. H. Hiorns questioned the statement that small percentages of manganese that exist in foundry irons had no influence on the physical properties of the metal.

T. Vaughan Hughes said that the state of the carbon in a malleable casting should be given with the analysis and added that a microscopical as well as a chemical examination was indispensable. Discussing heat treatment, he said that for the last 10 years, at the works with which he was connected, heat treatment had been applied to a great many machine accessories in a manner not generally known. One instance was that of crank shafts which are being cast in iron, turned to a rough finish, and by subjection to heat treatment, are converted into a form of mild steel. They are then case-hardened on the wearing surfaces and polished Thus, an iron casting displaces a mild steel bar or forging and he mentioned this interesting fact to show the improvements that had been effected as a result of the application of the scientific principles underlying suitable heat treatment.

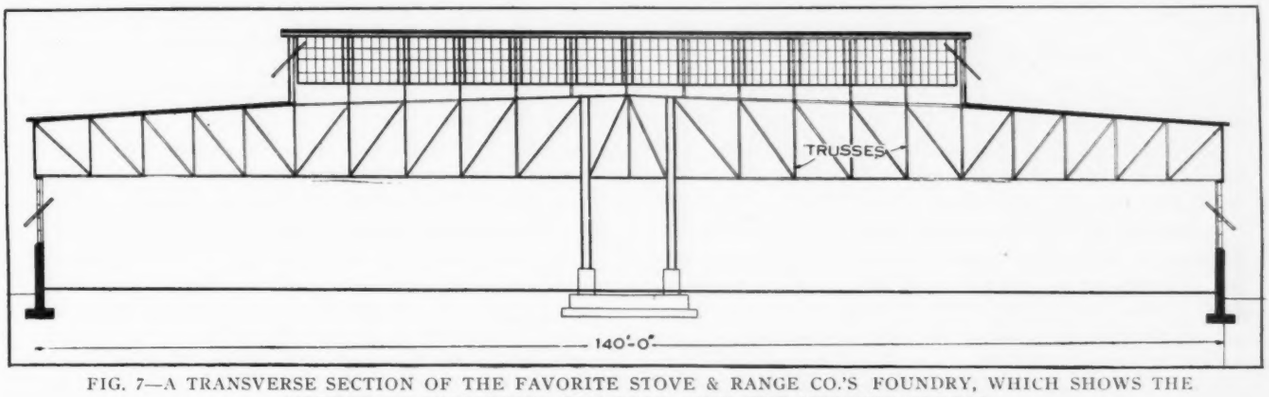


FIG. 7—A TRANSVERSE SECTION OF THE FAVORITE STOVE & RANGE CO.'S FOUNDRY, WHICH SHOWS THE METHOD OF SUPPORTING THE ROOF OVER THE MOLDING FLOORS

Porous Smelter Kettles

By W. J. Keep

Question:—We would like to obtain a gray iron mixture for slag kettles for smelter use. Our present mixture does not give us the service required. We have been using No. 1 southern iron containing 2.75 per cent silicon and machinery scrap.

Answer:—We presume that your castings are porous. We would suggest that you increase your percentage of machinery scrap until a denser metal is obtained. On the other hand, the temptation in the manufacture of these kettles is to take scrap kettles in exchange and to charge these in the cupola with the machinery scrap. The sulphur in machinery scrap approximates about 0.08 per cent and if a large amount is used, for example, one-half the mixture, and with the coke containing 1 to 1.25 per cent of sulphur, the castings will contain 0.08 per cent sulphur, which is the extreme limit. However, if you use scrap smelter pots in your mixture which contain 0.50 per cent sulphur or more, the castings will contain blow-holes. A lower silicon pig iron will give closer grain, and with it and your No. 1 pig iron, you might decrease the sulphur content sufficiently to insure sound castings. You might try the addition of powdered ferro-manganese in the ladle.

Preparations for the Foundrymen's Convention

PREPARATIONS now are being made for the exhibit of foundry equipment and supplies which will be held in the Broadway exposition building, Buffalo, during Founders' Week in the Bison city, bginning Monday, Sept. 23. Concurrent with this exhibit will be held the annual conventions of the American Foundrymen's Association, the American Institute of Metals and the Associated Foundry Foremen. The reconstruction of the exposition building has been practically completed and an unusually large number of applications for space already has been received. The indications are that the number of exhibits will exceed the total at Pittsburgh last year.

Any firm or individual manufacturing or selling foundry and pattern shop equipment and machine tools, or any article pertaining to the manufacturing industry may exhibit, providing he obtains a permit from the Foundry & Machine Exhibition Co. A charge of $25 is made for this permit and the price of space is 50 cents per square foot with an extra charge of 10 cents per square foot for corners. As far as possible the exhibits will be classified and the assignment of spaces will be made Aug. 1.

In a communication issued by C. E. Hoyt, secretary of the Foundry & Machine Exhibition Co., Lewis Institute, Chicago, the exhibitors are notified to have their displays installed before 9 a. m. Monday, Sept. 23. On Monday and Thursday the exhibition will be open from 9 a. m. to 10 p. m., and on Tuesday, Wednesday and Friday the exhibition will close at 6 p. m. No signs will be permitted except those approved by the management. These will be of uniform size and will be installed by the exhibition company. A general admission fee of 25 cents will be charged and season tickets for the week will be sold at the price of $1 each.

The exposition building is located on Broadway, a short distance from the principal Buffalo hotels. The floor of the building is wood laid on concrete on the ground level, there being no basement or excavation under any part. The entire floor space, 176 x 275 feet, is free from columns or posts with the exception of a row of posts 8 feet, 6 inches from the wall which support a balcony all around the building. The Exhibition company will provide, without cost to the exhibitors, compressed air at about 80 pounds pressure and electric current. Alternating current will be used in all cases except where it is absolutely necessary to have direct current. The General Electric Co., Schenectady, N. Y., will loan motors to exhibitors on condition that they pay all transportation expenses and insure the motors against damage other than ordinary wear. Exhibitors desiring to avail themselves of this opportunity should correspond directly with the General Electric Co.

The headquarters of the various organizations will be as follows: Foundry & Machine Exhibition Co., Hotel Lafayette; American Foundrymen's Association, Hotel Statler; American Institute of Metals, Hotel Iroquois, and the Associated Foundry Foremen, Hotel Broezel.

Association Meetings

The meetings of the American Foundrymen's Association will be held at the Hotel Statler, on Tuesday, Wednesday and Thursday, Sept. 24, 25 and 26. Dr. Richard Moldenke, secretary of the organization, already has announced that the papers which will be read will prove unusually interesting, particularly to steel and malleable foundrymen. An exhaustive report on molding sand tests will be submitted. The investigations of this problem have shown that widely varying results are obtained with sand in various foundries, which is due undoubtedly to the low cost of sand in such foundry districts and the consequent inattention to sand economy except when the disposal of the burnt sand becomes an acute problem. At the time when the molding sand tests were undertaken requests for sands were sent to all dealers in this commodity as well as to the members of the association. The response was generous and the results which will be reported are based upon the study of 80 natural molding sands, most of them well-known standards. In addition, there have been prepared 12 combinations of sand and fire clay, to form a series of artificial molding sands for foundry use. The physical tests of 92 different sands were made by Dr. Moldenke in addition to rational analyses, mineral determinations, etc.

The Institute of Metals, formerly the American Brass Founders' Association, promises an unusually interesting program and a large number of papers already have been prepared and have been submitted to Secretary W. M. Corse. The entertainment features, although not definitely outlined, will insure the visitors an enjoyable, though busy week.

Henry D. Miles, of the Buffalo Foundry & Machine Co., is chairman of the general committee in charge of the convention preparations and other committee chairmen follow: T. L. Richmond, Buffalo Machine Co.; W. H. Barr, Lumen Bearing Co.; Walter F. Semon, Frontier Iron Works, and Henry W. Wendt, Buffalo Forge Co. Frank W. Tracy, of the Buffalo chamber of commerce, is the special representative of this organization working in conjunction with the various foundrymen's committees.

Convention of British Foundrymen

The ninth annual convention of the British Foundrymen's Association will be held Aug. 6, 7 and 8, at Cardiff, Wales. The meeting will be held in the University College of South Wales and the following papers will be presented:

"Modern Brass Founding," by H. S. Primrose, Glasgow, Scotland.
"The Training of Apprentices," by J. W. Horne, Erith, Eng.
"Coking in South Wales," by R. H. Greaves, Cardiff, Wales.
"The Influence of Sulphur on Cast Iron," by H. I. Coe, Birmingham, Eng.
"Molding a Water-Jacketed Gas Engine Cylinder," by J. G. Robinson, Halifax, Eng.
"Patternmaking," by R. H. Schofield, Manchester Eng.
"Molding Sands," by A. B. Searle, Sheffield, Eng.

Among the plants that will be visited by the foundrymen are the Dowlais works of Guest, Keen & Nettlefold, and the Cardiff and Penarth docks and hydraulic plants. On Thursday, Aug. 8, the members will make a tour of Wye valley.

On the evening of the first day of the convention the members will be received by the mayor of Cardiff. The association now has a membership of 889 as compared with 674 a year ago.

Statistics of the American Foundry Industry

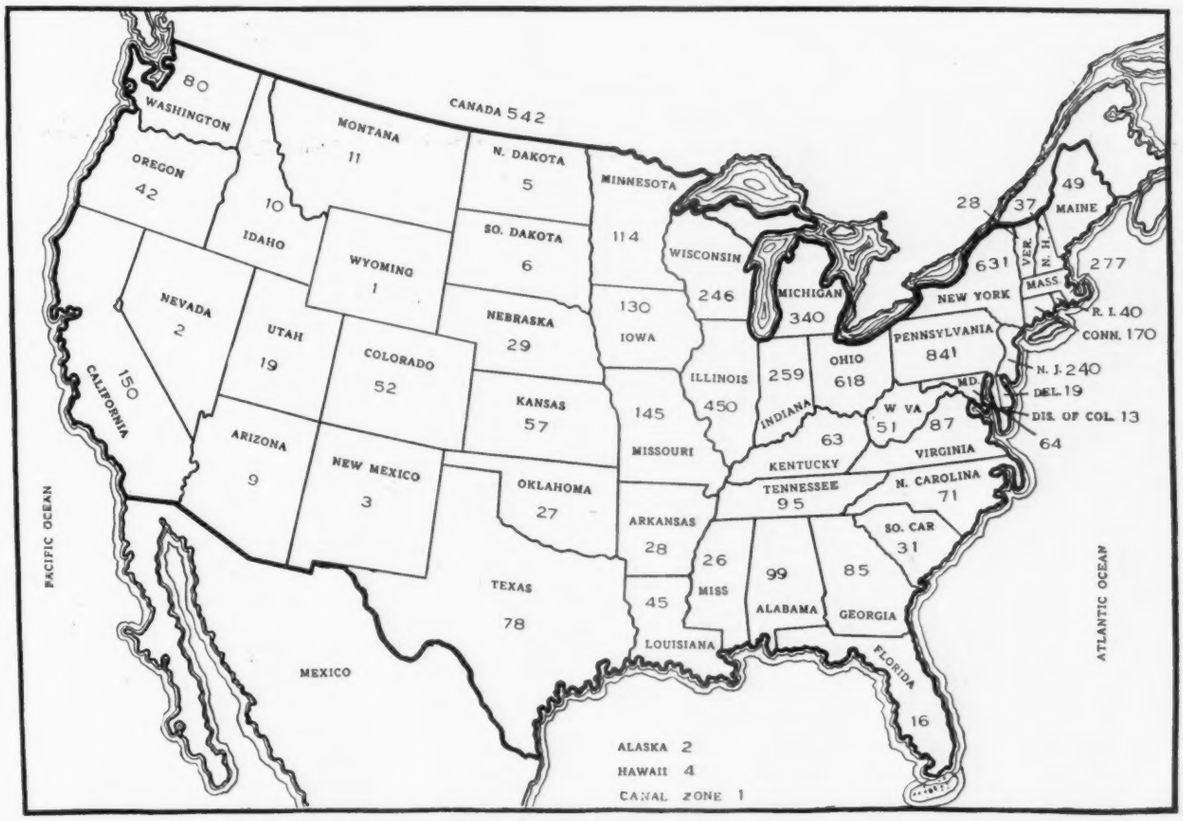
Distribution of the Shops in the United States and Canada on July 1, With Details of the Iron, Steel, Malleable and Brass Branches

STATISTICS of the foundry industry of the United States and Canada, compiled by THE FOUNDRY, show a total of 6,538 plants engaged in the manufacture of gray iron, steel, malleable, brass and aluminum castings on July 1, 1912. On April 1, 1910, there were 6,594 foundries in the United States and Canada, and the net loss in a period of two years and three months is 54. On April 1, 1908, the total casting plants aggregated 6,366 and the increase in two years, to April 1, 1910, was 228. In 1908 and early in 1909, many new shops were erected as the existing capacity was insufficient to meet the requirements of the trade. The business depression which followed and continued almost through 1911 was unparalleled in the history of the foundry industry and to this must be attributed the slight decline in the total number of shops. In this connection it is interesting to note that 495 new foundries were built from April 1, 1910, to July 1, 1912, and of this total, approximately 100 had ceased operation on July 1 this year. The severity of the trade depression is reflected by the number of casting companies that passed out of existence. A total of 405 plants discontinued operations and 333 foundries were absorbed by other plants. These figures indicate that the foundry industry has passed through an exceedingly trying period, although the present activity foreshadows the erection of a large number of new shops during the next two years. In the compilation of these statistics, additions and extensions to plants are not included. Many shops have increased their capacity during the last two years and while there has been a decline in the total number of foundries, nevertheless there undoubtedly has been a large increase in the theoretical melt. In 1906 there was a total of 6,108 casting plants in the United States and Canada and the increase in six years aggregates 430.

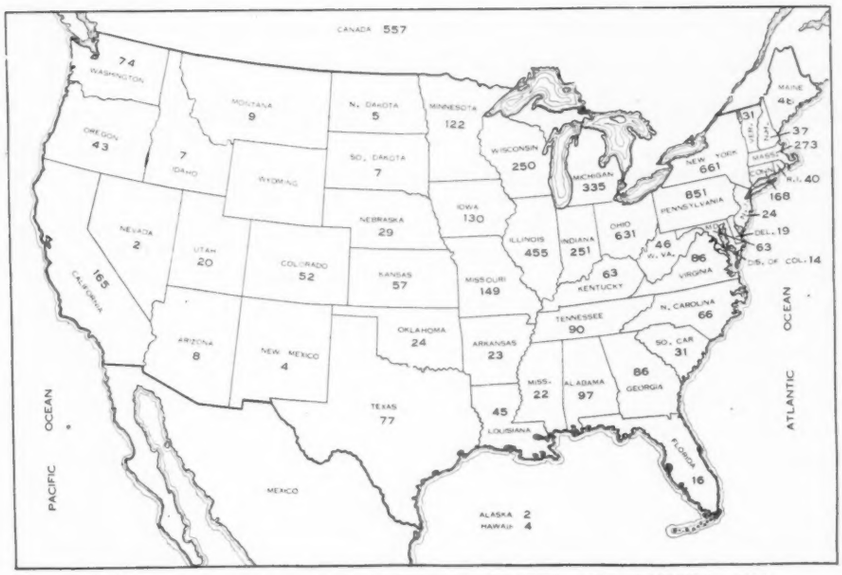
In compiling these statistics, each plant was considered as a unit, regardless of the number of departments it contained. All of the converter steel casting plants operate gray iron departments as the iron is first melted in cupolas before being charged into the converters. Also, practically all of the malleable shops melt gray iron for making annealing boxes and the brass departments of gray iron, steel and malleable foundries far exceed the exclusive brass shops. Considering each foundry department as a unit, there were 9,236 casting plants in the United States and Canada on July 1, 1912, as compared with 9,158, April 1, 1910, an increase of 78.

In Table 1 a comparison is made of the total foundries in the United States and Canada in 1912 and 1910. On July 1, this year, there were 5,996 casting plants in the United States, compared with 6,037 in 1910, a loss of 41. Canada has 542 foundries, against 557 in 1910, a loss of 15.

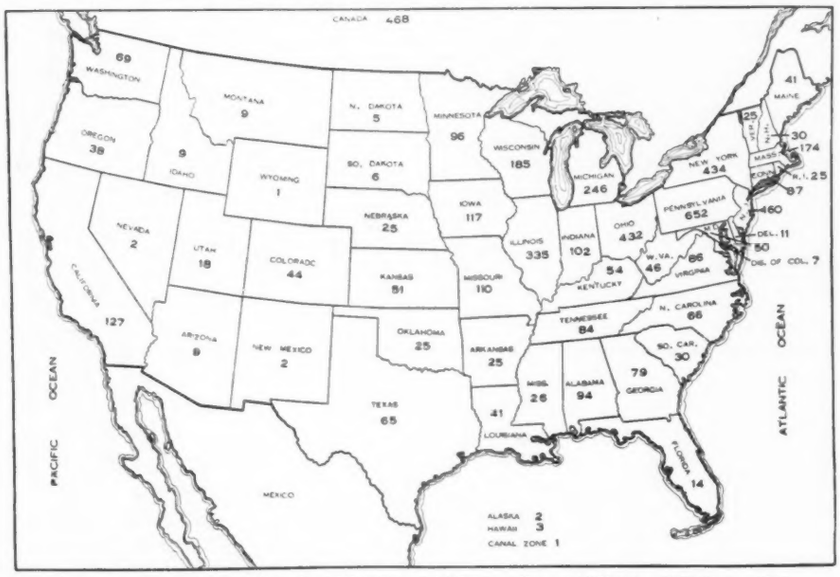
That the growing preference for steel castings is making big inroads in the gray iron branch of the foundry industry is indicated by the large decline in the number of gray iron shops. In the United States and



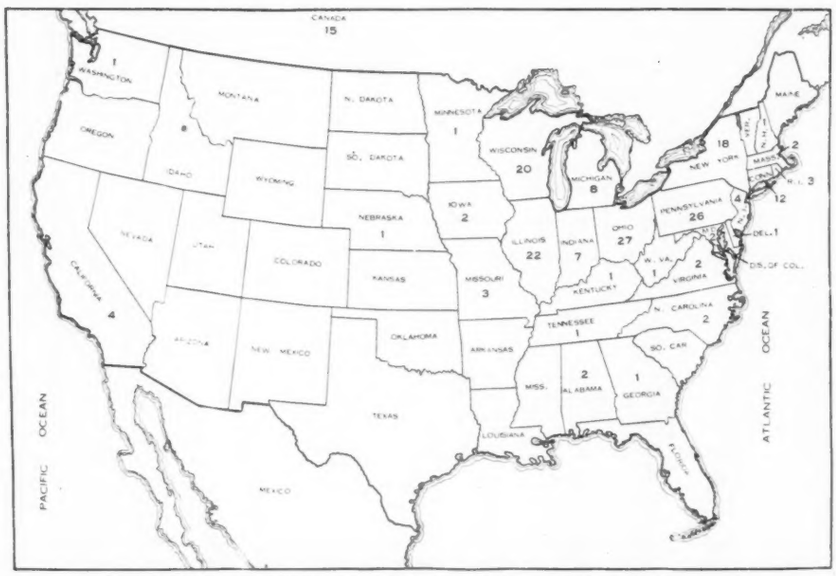
TOTAL NUMBER OF FOUNDRIES IN THE UNITED STATES AND CANADA, JULY 1, 1912.



TOTAL FOUNDRIES IN THE UNITED STATES AND CANADA, 1910



GRAY IRON FOUNDRIES, UNITED STATES AND CANADA, JULY 1, 1912



MALLEABLE FOUNDRIES, UNITED STATES AND CANADA, 1912

Canada there are 4,943 gray iron foundries, as compared with 5,157 in 1910, a loss of 214. Of this total there are 4,475 in the United States and 468 in Canada. In 1910 the United States had 4,680 gray iron plants and Canada 477, the losses in two years being 205 and 9, respectively.

The steel casting industry on the other hand, shows a remarkable growth. The net increase in the number of plants melting steel castings is 53, Canada being credited with two additional steel shops and the United States with 51. This phenomenal expansion in the steel casting producing capacity, to a large extent is due to the replacement of iron sections with cast steel. While no records are available of the classification of product, the number of converter installations far exceeds open-hearth and

Table I.

TOTAL FOUNDRIES IN THE UNITED STATES AND CANADA, 1912 AND 1910.

United States and Canada, 1912	6,538
United States and Canada, 1910	6,594
Total foundries, loss	56
Foundries in U. S., 1912	5,996
Foundries in U. S., 1910	6,037
Loss in U. S.	41
Foundries, Can., 1912	542
Foundries, Can., 1910	557
Loss in Can.	15

GRAY IRON FOUNDRIES IN THE UNITED STATES AND CANADA, 1912 AND 1910.

United States and Canada, 1912	4,943
United States and Canada, 1910	5,157
Total gray iron loss	214
Gray iron, U. S., 1912	4,475
Gray iron, U. S., 1910	4,680
Loss in U. S.	205
Gray iron, Can., 1912	468
Gray iron, Can., 1910	477
Loss in Canada	9

MALLEABLE FOUNDRIES IN THE UNITED STATES AND CANADA, 1912 AND 1910.

United States and Canada, 1912	190
United States and Canada, 1910	178
Increase.	12
United States, 1912	175
United States, 1910	168
Increase.	7
Canada, 1912	15
Canada, 1910	10
Increase.	5

STEEL FOUNDRIES IN THE UNITED STATES AND CANADA, 1912 AND 1910.

United States and Canada, 1912	318
United States and Canada 1910	265
Increase.	53
United States, 1912	299
United States, 1910	248
Increase.	51
Canada, 1912	19
Canada, 1910	17
Increase.	2

crucible. During the last two years the production of converter steel castings showed an increase proportionately greater than that of open-hearth, while the crucible process is almost stationary in output. Although there are comparatively few electric furnace installations for making steel castings, this process will show big gains in the next few years. The total number of steel foundries in the United States and Canada is 318, against 265 in 1910. These are distributed as follows: United States, 299, and Canada, 19. In 1910, the United States had 248 steel foundries and Canada 17. Pennsylvania leads with 78; Ohio follows with 34, and

Table II.

TOTAL OF EXCLUSIVE BRASS FOUNDRIES AND BRASS DEPARTMENTS OF OTHER PLANTS IN THE UNITED STATES AND CANADA, 1912 AND 1910.

United States and Canada, 1912.....	3,680
United States and Canada, 1910.....	3 558
Increase.	122
Total brass, U. S., 1912.....	3,389
Total brass, U. S., 1910.....	3,375
Increase.	14
Total brass, Can., 1912.....	291
Total brass, Can., 1910.....	183
Increase.	108

EXCLUSIVE BRASS FOUNDRIES IN THE UNITED STATES AND CANADA, 1912 AND 1910.

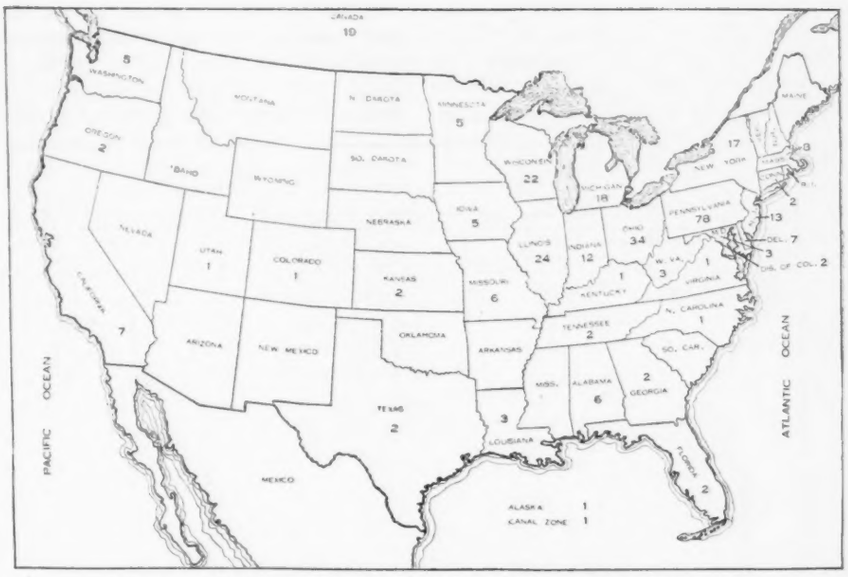
United States and Canada, 1912.....	1.258
United States and Canada, 1910.....	1,240
Increase.	18
Exclusive brass, U. S., 1912.....	1,197
Exclusive brass, U. S., 1910.....	1,170
Increase.	27
Exclusive brass, Can., 1912.....	61
Exclusive brass, Can., 1910.....	70
Loss	9

BRASS DEPARTMENTS OF GRAY IRON, MALLEABLE AND STEEL FOUNDRIES IN THE UNITED STATES AND CANADA, 1912 AND 1910.

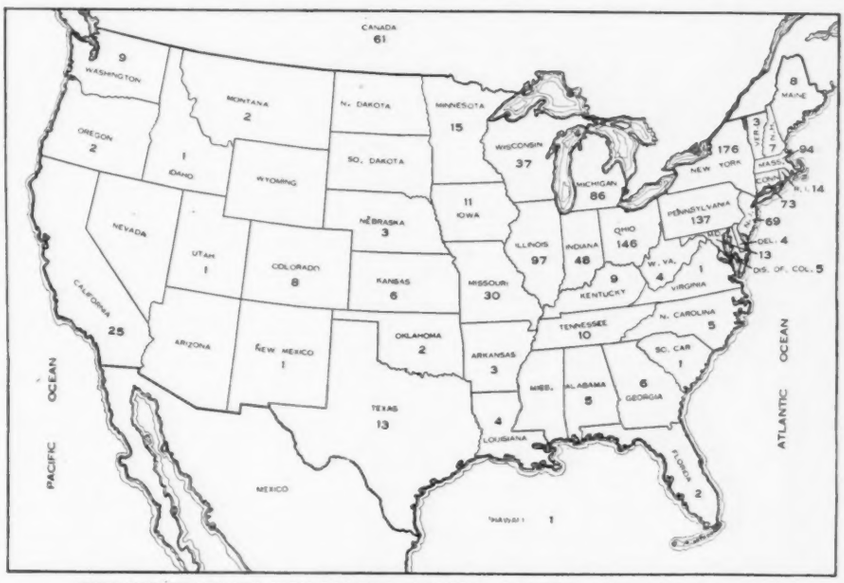
United States and Canada, 1912.....	2,408
United States and Canada, 1910.....	2,318
Increase.	90
Brass depts., U. S., 1912.....	2,178
Brass depts., U. S., 1910.....	2,205
Loss	27
Brass depts., Can., 1912.....	230
Brass depts., Can., 1910.....	113
Increase.	117

FOUNDRIES MELTING ALUMINUM IN THE UNITED STATES AND CANADA, 1912 AND 1910.

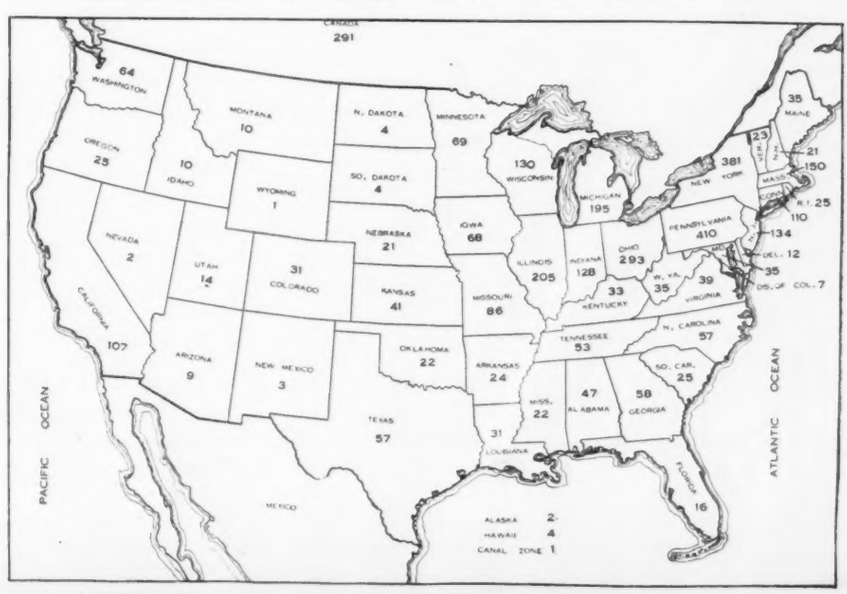
United States and Canada, 1912.....	2,019
United States and Canada, 1910.....	1,679
Increase.	340
United States, 1912.....	1,881
United States, 1910.....	1,569
Increase.	312
Canada 1912	138
Canada, 1910	110
Increase.	28



STEEL FOUNDRIES IN THE UNITED STATES AND CANADA, 1912



EXCLUSIVE BRASS FOUNDRIES, UNITED STATES AND CANADA, 1912



FOUNDRIES MELTING BRASS, UNITED STATES AND CANADA, 1912

Illinois and Wisconsin are third and fourth with 24 and 22, respectively.

The malleable iron industry is growing steadily, the number of plants in the United States and Canada having increased from 178 in 1910 to 190 in 1912. The net increase is 12, of which seven are credited to the United States and five to Canada. The distribution of plants in 1912 follows: United States, 175, and Canada, 15; 1910, United States, 168, and Canada, 10. The malleable iron melting capacity of existing plants also has been extended by the installation of a large number of furnaces, and while steel castings have made perceptible inroads into malleable, these statistics would indicate a normal increase in the output of malleable castings. Ohio leads with 27 malleable shops, and the other states rank in the following order: Pennsylvania, 26; Illinois, 22; Wisconsin, 20; New York, 18, and Michigan, 8.

Table III.

FOUNDRIES IN THE UNITED STATES AND CANADA BY STATES AND PROVINCES, 1912 AND 1910.

	Total foundries, 1912.	Total foundries, 1910.	Increase or decrease in two years.	Gray iron foundries, 1912.	Gray iron foundries, 1910.	Exclusive brass foundries, 1912.	Exclusive brass foundries, 1910.	Brass foundries departments of other shops, 1912.	Total brass foundries, 1912.	Malleable iron foundries, 1912.	Steel foundries, 1912.	Foundries melting aluminum, 1912.
United States:—												
Alabama	99	97	+2	94	92	5	4	42	47	2	6	18
Alaska	2	2	....	2	2	...	...	2	2	..	1	1
Arizona	9	8	+1	9	8	...	...	9	9	..	..	3
Arkansas	28	23	+5	25	21	3	2	21	24	..	..	11
California	150	165	—15	127	134	25	28	82	107	4	7	76
Canal Zone	1	...	+1	1	...	...	...	1	1	..	1	1
Colorado	52	52	...	44	45	8	7	23	31	..	1	17
Connecticut	170	168	+2	87	85	73	73	37	110	12	2	64
Delaware	19	19	....	11	9	4	4	8	12	1	7	5
Dist. of Columbia	13	14	—1	7	8	5	5	2	7	..	2	5
Florida	16	16	...	14	14	2	2	14	16	..	2	8
Georgia	85	86	—1	79	79	6	7	52	58	1	2	25
Hawaii	4	4	...	3	4	1	...	3	4	..	..	1
Idaho	10	7	+3	9	6	1	1	9	10	..	..	4
Illinois	450	455	—5	335	346	97	92	108	205	22	24	138
Indiana	259	251	+8	102	200	48	42	80	128	7	12	71
Iowa	130	130	....	117	119	11	9	57	68	2	5	44
Kansas	57	57	....	51	50	6	7	35	41	..	2	32
Kentucky	63	63	....	54	55	9	7	24	33	1	1	24
Louisiana	45	45	....	41	41	4	4	27	31	..	3	7
Maine	49	48	+1	41	39	8	9	27	35	..	..	17
Maryland	64	63	+1	50	47	13	14	22	35	2	3	16
Massachusetts	277	273	+4	174	177	94	88	56	150	2	8	89
Michigan	340	335	+5	246	246	86	82	109	195	8	18	125
Minnesota	114	122	—8	96	101	15	17	54	69	1	5	41
Mississippi	26	22	+4	26	21	...	1	22	22	..	..	6
Missouri	145	149	—4	110	116	30	32	56	86	3	6	49
Montana	11	9	+2	9	9	2	...	8	10	..	..	3
Nebraska	29	29	....	25	27	3	2	18	21	1	..	18
Nevada	2	2	....	2	2	...	...	2	2	..	..	...
New Hampshire	37	37	....	30	30	7	7	14	21	1	..	14
New Jersey	240	249	—9	160	169	69	69	65	134	4	13	72
New Mexico	3	4	—1	2	3	1	1	2	3	..	..	1
New York	631	661	—30	434	484	176	180	205	381	18	17	209
North Carolina	71	66	+5	66	61	5	5	52	57	2	1	24
North Dakota	5	5	....	5	5	...	...	4	4	..	..	2
Ohio	618	631	—13	432	452	146	147	146	293	27	34	171
Oklahoma	27	24	+3	25	23	2	1	20	22	..	..	11
Oregon	42	43	—1	38	39	2	3	23	25	..	2	15
Pennsylvania	841	851	—10	652	672	137	131	273	410	26	78	211
Rhode Island	40	40	....	25	27	14	12	11	25	3	..	13
South Carolina	31	31	....	30	31	1	...	24	25	..	..	10
South Dakota	6	7	—1	6	7	...	...	4	4	..	..	3
Tennessee	95	90	+5	84	77	10	12	43	53	1	2	30
Texas	78	77	+1	65	65	13	12	44	57	..	2	24
Utah	19	20	—1	18	19	1	1	13	14	..	1	8
Vermont	28	31	—3	25	26	3	5	20	23	..	..	9
Virginia	87	86	+1	86	86	1	...	38	39	2	1	30
Washington	80	74	+6	69	67	9	6	52	64	1	5	29
West Virginia	51	46	+5	46	42	4	3	31	35	1	3	11
Wisconsin	246	250	—4	185	192	37	36	93	130	20	22	64
Wyoming	1	...	+1	1	...	...	...	1	1	..	..	1
Total in United States	5 996	6,037	*—41	4,475	4,680	1,197	1,170	2,178	3,389	175	299	1 881
Canada:—												
Alberta	4	4	....	4	4	...	1	3	3	..	..	2
British Columbia	19	18	+1	18	17	1	...	14	15	..	1	6
Manitoba	12	11	+1	10	10	2	1	6	8	..	1	5
New Brunswick	24	24	....	20	20	4	4	13	17	..	..	4
Newfoundland	2	2	....	1	1	1	1	...	1	..	..	...
Nova Scotia	37	36	+1	32	32	4	4	20	24	1	2	7
Ontario	330	348	—18	284	294	37	46	128	165	9	6	84
Prince Edward Island	4	4	....	4	4	...	...	2	2	..	..	...
Quebec	108	109	—1	94	94	12	13	42	54	5	8	29
Saskatchewan	1	....	+1	1	....	...	...	1	1	..	..	1
St. Pierre Et Miquelon	1	1	....	....	1	...	...	1	1	..	1	...
Total in Canada	542	557	*—15	468	477	61	70	230	291	15	19	138
Total in United States and Canada	6,538	6,594	*—56	4,943	5,157	1,258	1,240	2,408	3,680	190	318	2,019

*Net Decrease.

The manufacture of brass castings shows a greater growth than any other branch of the foundry industry. This, in large measure, is due to the expansion of the automobile

industry and in the leading motor car building centers the increase in the number of brass foundries is most pronounced. In compiling the statistics of the brass foundry industry, care was exercised to secure accurate data regarding brass shops exclusively, and those operated as departments of gray iron, steel and malleable foundries. The total number of plants melting non-ferrous metals in the United States and Canada in 1912 was 3,680, against 3,558 in 1910, an increase of 122. The United States had 3,389 in 1912 and 3,375 in 1910, while Canada records the remarkable increase of 108 in two years, having had 183 plants melting non-ferrous metals in 1910, which has been increased to 291 in 1912. The exclusive number of brass shops has been increased a net total of 18, from 1,240 in 1910 to 1,258 in 1912. The United States has 1,197 exclusive brass foundries and Canada, 61. Gray iron, steel and malleable foundries in the United States and Canada operated 2,408 non-ferrous metal departments in 1912, as compared with 2,138 in 1910, a net increase of 90.

Foundries Melting Aluminum

Aluminum is being melted more extensively in all kinds of foundries as a total of 2,019 shops reported casting this white metal in 1912, against 1,679 in 1910, an increase of 340. In the United States, 1,881 foundries are equipped to make aluminum castings, and in Canada there are 138 shops.

The accompanying charts graphically show the distribution of the casting plants throughout the United States and Canada, and Table III gives the total number of foundries by states and furnaces. Pennsylvania leads by a wide margin with 841 and the other states rank in the following order: New York, 631; Ohio, 618; Illinois, 450; Michigan, 340; Massachusetts, 277; Wisconsin, 246; New Jersey, 240; Connecticut, 170, and California, 150. In Canada the Province of Ontario leads in the number of foundries with a total of 330, and the Province of Quebec follows with 108.

Leading Foundry Centers

Chicago continues to rank first among the leading foundry centers of the United States, with New York City, second; Philadelphia, third, and Pittsburgh fourth. There has been a decline in the number of casting shops in the large cities of the United States, which is due to the high cost of foundry sites and the inability to obtain adjoining properties for extensions. Many foundries have been removed to new sites in the vicinity of these large centers where ample property can be purchased at a comparatively small cost to carry on foundry operations without restriction. Chicago has 169 foundries, as compared with 174 in 1910, and New York, with a total of 128 shops, suffered a loss of 20 in two years. Philadelphia now has 119, a loss of three. Pittsburgh, with 109 foundries, shows an increase of 16, and Detroit, ranking fifth among the foundry centers, has 98 plants, an increase of five since 1910. In Canada, Toronto leads with 44 casting plants, a net increase of two in two years.

Table IV.

LEADING FOUNDRY CENTERS OF THE UNITED STATES AND CANADA.

	Total foundries, 1912.	Total foundries, 1910.
Chicago	169	174
New York City	128	148
Philadelphia	119	122
Pittsburgh	109	93
Detroit	98	93
Cleveland	91	92
Cincinnati	74	76
Milwaukee	69	67
Buffalo	66	61
St. Louis	63	63
Newark	54	52
Boston	49	51
Toronto	44	42
Minneapolis	39	40
San Francisco	38	46
Baltimore	37	41
Indianapolis	32	31
Birmingham	31	30
Louisville	30	28
Montreal	29	30
Erie	29	28
Chattanooga	27	28
Dayton	27	28
Rochester	27	24
Toledo	25	27
Kansas City	25	24
Reading	24	25
Atlanta	23	22
Jersey City	22	28
Bridgeport, Conn.	22	20
Worcester, Mass.	21	22
Providence, R. I.	19	21
Seattle	19	18
Portland, Ore.	18	18
Racine, Wis.	18	18
Hamilton, Ont.	17	18
New Haven	16	18

Exhibition of Non-Ferrous Alloys

The International Exhibition of Non-Ferrous Alloys, held recently in London, reflected tremendous development in the production of alloys adapted to the diversified needs of modern industries. The exhibition was not entirely confined to non-ferrous metals and alloys, as some of the alloys shown were more closely connected with the iron and steel industries than with those of copper. The exhibition was entirely confined to still exhibits, no demonstrations of either metallurgical or mechanical processes being attempted, but it was noteworthy as showing the diversified character of the various alloys that have been developed to meet special conditions. The corrosion of condenser tubes is a subject that has attracted much attention, and the attempts that have been made to solve this problem were embodied in two alloys exhibited by the Yorkshire Copper Works, Ltd., Leeds, Eng.

One of these alloys, known as Bemal metal, has been employed successfully in competition with the brass mixtures ordinarily used for the same purpose. The other alloy is called Leespec metal and is intended for boiler tubes. It has a guaranteed tensile strength of 38,000 pounds per square inch with from 55 to 60 per cent elongation. This alloy is claimed to be able to withstand a considerable increase in temperature without material loss of strength; at 392 degrees Fahr. the tensile strength decreased only about 1,000 pounds, while the elongation remained at 69 per cent. Another alloy exhibited by the same company is known as Gumal metal, a gun metal adapted for castings exposed to acids. The exhibit of Thermit, Limited, London, included such alumino-thermic products as chromium, titanium, molybdenum and other metals and ferro-alloys, also an alloy used as a deoxidizer of brass known as Sab brass alloy, which is claimed to materially improve the physical properties of the brass to which it is added.

A number of aluminum alloys were shown, among which were duralumin, sulphalium and vanalium. The first of these is well-known, and is suitable for rolled and drawn shapes; the second is a casting alloy not liable to blow-holes, with a low shrinkage and unaffected by sea water; the third metal, vanalium, is 3 per cent heavier than aluminum and can be rolled and cast. When cast it is said to have a tensile strength of 24,640 pounds per square inch; elongation, 8 per cent in 2 inches, and an elastic limit of 18,000 pounds per square inch. It melts at about the same temperature as aluminum, can be readily soldered and is unaffected by corrosion. Other exhibits included phosphor bronze, manganese bronze, Delta metal, nickel, German silver and anti-friction alloys.

"Technical Graduates Versus Foundry Foremen and Superintendents" is the title of an eight-page booklet published by McLain's System, Goldsmith building, Milwaukee. The position of the college graduate in the foundry is contrasted with that of a foundryman trained by the McLain system.

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Trade Outlook

FOUNDRY operations continue to be restricted by the shortage of common labor and skilled molders. Every branch of the industry is affected and the labor scarcity is widespread. In the central west the demand for harvest hands has reduced the working forces of many shops. Wage increases have not solved the problem and the decline in the immigration foreshadows a more acute shortage in the future. The enactment of more stringent immigration laws, now proposed, will only enhance existing difficulties and foundrymen are besieging their legislative representatives to defeat the measure, if possible. The available foundry tonnage is in excess of the melt and deliveries, on steel castings particularly, are being deferred. Prices have not yet been advanced sufficiently to enable the foundrymen to earn a fair profit on their operations, although in the gray iron jobbing trade higher quotations are being made in some centers. A large number of contracts for automobile work have been placed during the last 30 days and the requirements of the builders of motor cars are greatly in excess of their last year's demands. Pig iron quotations are firm and in some districts have been slightly advanced. In the leading producing centers, No. 2 foundry iron is quoted as follows: Chicago, local, $14.50; Pittsburgh, $14.40; Cleveland, $13.75; Philadelphia, $15.00, and Birmingham, $11.00.

The Foundry Industry in 1912

ELSEWHERE in this issue are published our biennial statistics of the foundry industry of the United States and Canada. If trade conditions were measured by the number of new shops erected during this two-year period, an unusually prosperous era would be reflected. In spite of the depression, however, 495 new foundries began operations since April 1, 1910, but our figures show further that nearly 100 of these new companies passed out of existence before July 1, this year. In addition, a total of 405 foundries was reported out of business and 333 shops were absorbed by other companies. These changes are unparalleled in the history of the industry and reflect the exceedingly unsettled conditions which prevailed until the beginning of this year. The most remarkable growth is shown by the steel casting branch of the foundry trade. This is due to the growing preference for steel over gray iron for sections subjected to great stresses. In number of installations, if not in capacity, the converter leads all processes in the total erected during the last two years. The small unit, in steel casting manufacture, is preferred by foundrymen making occasional heats and the converter is unusually well-adapted to this method of operation. Several electric furnaces are now being successfully operated and the indications point to the more extensive use of this type of melting medium in steel casting shops. That the total foundry melting capacity has increased, notwithstanding the slight decline noted in the total number of shops, is indicated by the large number of extensions made since 1910. The number of malleable plants increased normally, although there was a reduction in the total gray iron shops. The increase in the brass foundries was not wholly unexpected owing to the increased demand for non-ferrous metal castings for the automobile trade. The figures also indicate that many shops have installed equipment for melting aluminum.

Personal

Charles Vickers, editor of the nonferrous casting department of THE FOUNDRY, has resigned to engage in experimental work for the Titanium Alloy Mfg. Co., at Niagara Falls, N. Y. For many years Mr. Vickers was a contributor to THE FOUNDRY on brass foundry topics and to strengthen this department he became affiliated with this publication 2½ years ago. His work throughout this period is the best tribute to his ability and painstaking effort. Arrangements have been made with Mr. Vickers to insure the readers of THE FOUNDRY his interesting observations on brass foundry practice and this department will continue under his supervision.

James M. Swank, general manager of the American Iron and Steel Association and editor of the BULLETIN, issued by that organization, attained his eightieth year on July 12. In 1873 Mr. Swank became secretary of the American Iron and Steel Association and was advanced to the position of vice president and general manager in 1885. He is in active personal charge of the important statistical work of the association and discharges the responsible duties of his two offices in this organization.

J. H. Bruce has been elected secretary and treasurer of the Bowler Foundry Co., Cleveland, succeeding H. J. Showe, resigned.

International Congress For Testing Materials

Announcement of the tentative program has been made by the committee in charge of the sixth congress of the International Association for Testing Materials, which will be held in New York in the Engineering Societies building, Sept. 2 to 7. On Monday, Sept. 2, the headquarters will be opened for the registration of members and on Tuesday morning the congress will convene at 10 o'clock. Addresses of welcome will be delivered by the acting presdent of the international association, Dr. Henry M. Howe, and by national, state and municipal officials. The various sections will then arrange for their sessions, which will convene at 2 p. m. On Wednesday, section sessions will take place from 10 to 12 a. m., while the afternoon and evening will be occupied by an excursion to West Point. On Thursday, sessions will begin at 10 a. m. and 2 p. m. and in the evening a reception will be tendered by the American Society of Civil Engineers in its bulding at 220 West Fifty-seventh street. Section sessions will be held in the morning and afternoon on Friday and in the evening there will be an excursion down the harbor. The congress will adjourn at noon on Saturday, a general session having been arranged which will be called at 10 o'clock on that day.

The list of papers announced is unprecedentedly large and including reports more than 150 manuscripts are promised. About 35 American papers are included in the list. The proceedings of the congress will be conducted in English, German and French, with the aid of competent interpreters. Among the foreign papers already received are the following:

"Resilience of Red Copper," by H. Baucke.
"Investigations of Bearing Metals for Machines."
"Methods of Testing Cast Iron," by Asboth and Kail.
"Nature of the Welding of Iron and Steel and Practical Applications," by M. Bermann.
"Testing Consignments of Steel and Iron on the Basis of their Chemical Composition," by M. Bermann.
"Principles for the Organization of Public Laboratories for Testing Materials," by A. Martens.

Eye Protection for Foundry Employes

The employment of eye protectors for foundry workmen, particularly those engaged in chipping and grinding castings, is rapidly increasing and the subject of proper eye protection has been given careful consideration by the manufacturers of this safety appliance. T. A. Willson & Co., Inc., Reading, Pa., are now manufacturing an eye protector, the frame of which is made of metal which will not rust and the temples are soft and flexible to prevent cutting the ears. The weight of this eye protector, which is known by the trade name of Albex, does not rest upon the top of the nose, but upon the sides and upper portions of the cheek, thus adding to the comfort of the workmen and at the same time effectively closing the usual points of entrance of dust and flying particles. The sides of the eye are protected by small folding leather flaps which extend away from the face, however, in such a way as not to overheat the eye or to prevent perfect ventilation.

Aktiebolaget Axel Christiernsson, Stockholm, Sweden, has established a branch office for the sale of foundry equipment and supplies at Moscow, Russia. This company would like to receive catalogs and price lists from American manufacturers of foundry equipment and supplies, patternmaking machinery, etc. The address of the Moscow office follows: Actien-Gesellschaft Axel Christiernsson, Mjasnitzkaja 15.

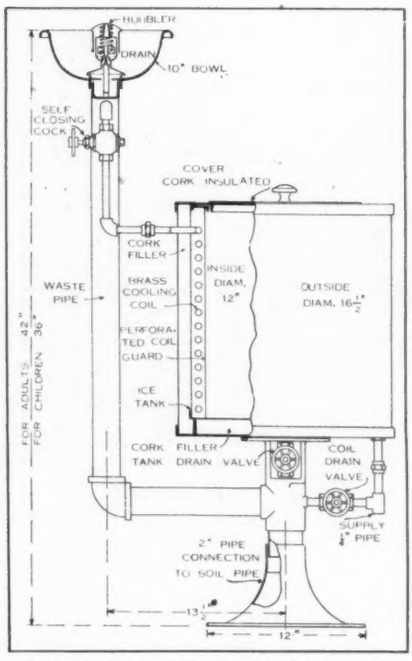
French Molding Machine Installation

Ph. Bonvillain & E. Ronceray, Paris, France, manufacturers of molding machines and labor-saving molding equipment, recently have made the following installations in French casting plants: MM. Collignon, Deville, malleable foundry, one universal and one rotary molding machine, including hydraulic equipment; MM. Crepel Hardy, Nouzon, malleable foundry, one universal and one rotary molding machine; MM. Gailly Freres, Charleville, malleable foundry, one universal and one rotary molding machine, one assembling machine, one machine for double face molding and one double face pattern plate appliance; MM. Cochaux, Deville, iron foundry, two lever machines; La Mercerienne, Mesieres, malleable and iron foundry, four universal molding machines; Fonderie Nouvelle, Charleville, iron foundry, four lever machines; MM. Villaime & Fils, Charleville, iron foundry, two molding machines; Biard Freres, Vierzon, iron foundry, two hydraulic molding machines, one assembling machine, one pattern appliance and hydraulic equipment; Riviere Pere & Fils, Quimperle, iron foundry, one hydraulic molding machine; Seguin & Cie, Lyon, brass foundry, four molding machines and hydraulic equipment; Fonderies De Fonte & D'Acier D'Hirson, steel foundry, one assembling machine; Demoulin, Choisy-le-Roi, aluminum foundry, two hydraulic and two rotary molding machines, one pattern plate appliance and one assembling machine; Fonderies De Saint-Ouen, near Paris, brass foundry, two drawing-off machines; Firm Gruer, Auxerre, iron foundry, one molding machine; Acieries De Rhone, Lyon, steel foundry, one hydraulic and one rotary molding machine, one assembling machine, one pattern plate appliance and hydraulic equipment; MM. Marmonnier, Lyon, iron foundry, one hydraulic machine and equipment; Firm Mercier, Dol-De-Bretagne, iron foundry, one universal molding machine, one assembling machine, pattern plate and hydraulic equipment; Fonderies De Conches, Conches, iron foundry, two universal molding machines, one assembling machine and one pattern plate appliance; Hauts Fourneaux & Fonderies De Pont-A-Mousson, pipe foundry, one universal and one rotary molding machine, one assembling machine and one pattern plate appliance; Societe Francaise des Acieries de Blanc Misseron, steel foundry, five universal and one rotary molding machine; Fonderie De

La Tossee, Tourgoing, iron foundry, one universal molding machine, pattern plate and hydraulic equipment; Usines & Acieries De Feignies, steel foundry, two universal molding machines, one assembling machine and pattern plate appliance.

Molding machine installations in Belgium: Societe La Brugeois, steel foundry, one hydraulic molding machine; Acieries Henricot, Court St. Etinne, steel foundry, two hydraulic molding machines and one assembling machine; Heuze Frison, Auvelais, iron foundry, one lever machine; Fonderies Et Poeleries De Tamines, iron foundry, one machine for double face molding.

Molding machine installations in Italy: Gaia & Garonne, Turin, aluminum foundry, five hydraulic and one rotary molding machine, two assembling machines and pattern plate appliances; MM. Necchi, Pavie, iron and malleable foundry, two machines for double face molding and one double face pattern plate appliance.



ICE-COOLED SANITARY DRINKING FOUNTAIN

Molding machine installation in Portugal: Empreza Industrial Portuguez, Lisbon, iron foundry, one assembling machine.

Molding machine installations in Spain: Miguel Del Prado, Valladolid, iron foundry, one universal molding machine, one pump and accumulator and pattern plate appliance; Arias & Diez, Placencia, malleable foundry, one double face molding machine and one double face pattern plate appliance.

Molding machine installations in Germany: Thyssen & Cie Maschinenfabrik, Mulheim, four molding machines; Meier & Weichelt, Liepzig-Lindemau, one hydraulic, one rotary and two universal molding machines; Fischer & Sohne, Traisen, two molding machines; Ludwig Loewe, Berlin, two molding machines; Gusswerke A. G., Frankenthal, two molding machines; R. R. Nordwestbahn, Reichehberg, one hydraulic molding machine; Eisenhuttenwerk Kablshutte, Kablshutte, one pattern plate appliance; H. A. Buttner, Aerdingen, one assembling machine; Hessen-Nassauischer Huttenverein, Ludwigshutte, six molding machines; H otfengartner, Holambkau, four molding machines and one pattern plate appliance; Neisser Eissengiesserei Kahn & Koplowitz, Neisse-Neuland, one rotary molding machine and pattern plate appliance; Huttenamt Bodenw o h r, Bodenwohr, two molding machines; Hessen Nassauischer Huttehverein, Amalienhutte, three molding machines and pattern plate appliance.

Molding machine installations in Austria-Hungary: Johann Weitzer, Arad, four molding machines and pattern plate appliance; Machinenfabrik Kgl. Stottsbalemn, Budapest, one hydraulic and one rotary molding machine; Gebr, Hardy Giesserei, Vienna, two hydraulic molding machines; Babcock Wilcox, Oeberhausein, five molding machines.

Molding machine installation in Switzerland: G. Fischer, Schaffouse, two hydraulic molding machines.

Ice-Cooled, Sanitary Drinking Fountain

An ice-cooled sanitary drinking fountain, manufactured by the Manufacturing Equipment & Engineering Co., Boston, is shown in the accompanying illustration. The ice-cooling tank is provided with a cork-packed jacket and is equipped with a long coil of brass pipe with a heavy ice guard. The supply and waste pipes are principally enclosed inside of the pipe and tank structure. The standard is made of 1½-inch pipe and the cast iron waste bowl is furnished in 10 and 12-inch sizes. The water supply is controlled by a self-closing bibb and the water is furnished through a bubbler. It is so constructed that it regulates automatically the height of the flow of water in the bubbler. The tank is of galvanized iron construction and is 16½ inches in diameter. The height of the fountain is 42 inches.

In 1911, the production of steel castings and ingots amounted to 23,675,501 tons, a decrease of 2,419,418 tons from the previous year.

The Osborne Vibrator

The Osborn Mfg., Cleveland, is now manufacturing a vibrator which is absolutely positive in its operation at all times and is guaranteed against sticking. The vibrator may be attached either to the pattern plate or to the molding machine, and is built in five sizes from ⅜ to 1⅜ inches. The positive action of the vibrator is due to the extreme accuracy of its manufacture. The vibrator body is made of high grade cast iron and the steel pinion is sufficiently heavy to impart ample strength to this device. A good bearing surface is provided by the use of steel against cast iron. In either end of the body hardened tool steel pins are set which receive the blow of the piston. A tempered steel wire spring is sunk into one end of the vibrator and surrounds the pin. The arrangement of the ports is one of the important features of this device and these are so located that they prevent the vibrator from sticking and insure its starting instantly when the air is admitted. All of the parts are carefully machined and this, in large measure, aids in making the vibrator positive in its action. Each vibrator has a convenient oil inlet and is individually inspected. The

THE NEW OSBORN VIBRATOR

Osborn Mfg. Co. also has built a new knee valve for use with any type of vibrator. The valve is so constructed that the workman can operate it with his knee when his hands are otherwise employed.

How to Paint Patterns

At a joint meeting of the Steel Founders' Society and the American Society for Testing Materials, the subject of coloring patterns for steel castings was discussed and a uniform system was adopted. The finished surface is to be painted red, the rough surface yellow and all core prints are to be painted black. The Treadwell Engineering Co., Easton, Pa., is sending to the trade a card containing a pattern in colors which clearly shows the scheme adopted by these two organizations.

The Rockwell Furnace Co., 26 Cortlandt street, New York City, is installing a large, over-fired heat-treating furnace in the plant of the New Process Steel Corporation, Lancaster, Pa. This furnace will be used for annealing steel wire, bars, etc.

A Draftless Stoking Door for Air Furnaces

In the operation of air furnaces the first essential is the attainment of the maximum melting temperature and this can be obtained only by the accurate adjustment of the fuel and air ratio. If this is maintained uniformly, a high temperature will be attained in the furnace. However, this ratio will constantly fluctuate, as a result of opening the fire box door for coaling, stoking, etc. To insure a uniform temperature throughout the heat, D. J. Carson, Lancaster, N. F., has designed a draftless stoking door and fire box for air furnaces, as shown in the accompanying illustration. The coal is charged into a hopper directly above the fire box. The bottom of the hopper consists of a swinging door normally in a horizontal position and which is lowered when discharging the fuel into the fire box. The door is hinged at one side and is lowered by operating the lever at the right. After the fuel has been discharged the door is returned to its original position and the fuel is distributed over the fire by inserting a poker through the opening in the sliding rail directly underneath the stoking door. This rail operates on two wheels to permit of adjusting the stoking opening at any point underneath the door. By this method the furnace can be fired without opening the stoking door, effecting a saving of fuel and greatly reducing the time required for firing and making a heat. As the stoking door is not opened, cold air does not enter the furnace when firing and difficulties from long heats and oxidized metal are eliminated. This type of fire box and stoking door has been in successful use for several years in a number of malleable iron plants. It is attached to the furnace with bolts and in front of the stoking door opening.

Trade Notes

Dan Campbell has been added to the sales force of the Chicago Fire Brick Co., Chicago.

The Hill & Griffith Co., Cincinnati, has established a warehouse at Pittsburgh, where a complete line of foundry facings, supplies and equipment will be carried in stock. James A. Carey is resident manager.

The Wiener Machinery Co. has moved into larger quarters in the new annex of the Hudson Terminal building, 50 Church street, New York City. The capital stock of the company was recently increased to $50,000.

J. T. Georgeson, formerly connected with the machinery department of J. T. Ryerson & Son, Chicago, is now associated with the Vulcan Engineering Sales Co., 2014 Fisher building, Chicago, and has been placed in charge of the sales of the products of the Q. M. S. Co. New lines shortly will be added to this department.

The August number of the *Merry Molder,* published by the Osborn Mfg. Co., Cleveland, will contain articles and illustrations which will show the extensive employment of molding machines in foundries engaged in the production of automobile castings, including cylinders, pistons, piston rings, crank cases, etc.

The Mott Sand Blast Co., 24 South Clinton street, Chicago, has sold the right to manufacture its sand blast machinery in the eastern territory to the De La Vergne Machine Co., East 138th street, New York. This concern manufactures refrigerating equipment, oil engines, gas producers, etc., and will have the exclusive manufacturing and selling rights in the east for the Mott sand blast machine.

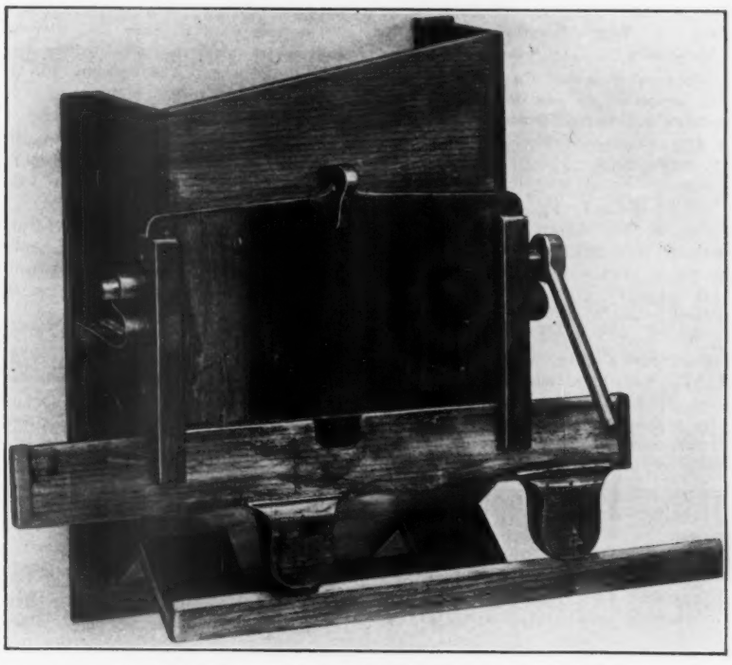
"Joseph Dixon, One of the World Makers", is the title of an essay written by Elbert Hubbard, and which has been issued in book form by the Joseph Dixon Crucible Co., Jersey City, N. J. Mr. Hubbard refers to Joseph Dixon as "a man whose work has profoundly influenced civilization, yet strangely enough of whom the world at large knows little." Owing to the limited edition of this booklet copies are only distributed by request.

High Sulphur

By W. J. Keep

Question:—Can you tell us how we got 0.101 per cent of sulphur in our castings when our charge consisted of 15 per cent pig iron containing 0.029 per cent sulphur; 15 per cent of iron containing 0.018 per cent sulphur; 20 per cent of iron with 0.019 per cent sulphur and 50 per cent of scrap containing 0.101 per cent sulphur? Our coke has a sulphur content of 0.72 per cent.

Answer:—Allowing for an increase of sulphur of 0.04 per cent in your coke, which is considered large, you should have exactly 0.101 per cent sulphur in your castings. This percentage of sulphur is not high nor is it unusual for the stove plate castings you manufacture. Particularly is this true considering the fact that you use 50 per cent of scrap. The iron, however, does not take up the same quantity of sulphur each day. Occasionally it may be as low as 0.065 per cent, which would indicate that only a very small amount has been absorbed from the coke. I do not know whether this is due to atmospheric or melting conditions. Nevertheless, it is a fact. Your combined carbon is 0.55 per cent and the total carbon is 3.24 per cent. As the carbon content is comparatively low, it is favorable to high sulphur. You can safely increase the silicon to 3 per cent with such a low carbon content. This would decrease the percentage of combined carbon and would probably result in a decrease of sulphur.



DRAFTLESS STOKING DOOR FOR AIR FURNACES

General Industrial Notes

The McDermott Machinery & Foundry Co., Iron River, Mich., has been incorporated with a capital of $25,000 to operate a foundry and machine shop.

The Santa Fe Foundry Co. of California, San Francisco, has been incorporated with a capital of $50,000 by J. W. Mason, J. C. Owens, G. W. Penning and G. C. Gross.

The Atlas Crucible Steel Co., Dunkirk, N. Y., has been incorporated with a capital of $300,000. The incorporators are Edward and Chas. P. Burgess, Arthur A. Hunter, Henry H. Droege and Edward J. West.

The Canadian Steel Foundries' new plant at Longue Pointe, Que., will shortly begin operations. This concern, which is one of the subsidiaries of the Canadian Car & Foundry Co., will engage in the manufacture of steel castings.

The Gary Semi-Steel & Foundry Co., Gary, Ind, incorporated with a capital of $30,000, will operate a foundry and machine shop. The incorporators are W. A. Cain, P. J. McGaffery, C. Rice, Timothy Holland and O. S. McGinnity.

The Monarch Foundry Co., Los Angeles, Cal., has completed its new foundry at Fifty-second street and Santa Fe avenue, and is installing two cupolas of five and eight tons capacity, respectively. This plant will engage in the manufacture of gray iron castings.

The Elliott-Bedford Foundry Co., Long Island City, N. Y., recently incorporated with a capital of $100,000, will engage in the manufacture of gray iron castings. The company has acquired the plant of the John Pirkl Foundry Co., at Broadway and Orchard streets, Astoria.

The MacCordy Casting Machine Co., Fabius, N. Y., has been incorporated with a capital of $25,000 to engage in the manufacture of casting machines and metals. The incorporators are C. A. MacCordy, J. A. McDonnell and E. L. Vezine, all of Syracuse, N. Y.

The Haydenville Co., Haydenville, Mass., manufacturer of brass and iron goods for water, steam and gas, has absorbed the Bay State Brass Co., of Haydenville. This plant will be operated under separate management. Both companies operate foundries for the manufacture of plumbers' brass goods.

J. Collins, for the past 12 years foreman of the foundry department of the Empire Foundry & Harvester Works, Marysville, Cal., has purchased from the company the foundry department together with all patterns. For the present the plant will be operated at its present location and iron, brass, bronze and aluminum castings will be made.

The Dalton Foundry, Warsaw, Ind., recently damaged by fire, is again operating in full. Within a few days after the fire the loss of core boxes and patterns was accurately ascertained and all of the company's customers were notified to replace core boxes and patterns at the Dalton Foundry company's expense.

The Western Malleable Castings, 426 Consolidated Realty building, Los Angeles, Cal., has erected a new plant at Fifty-second and Alameda streets. The company will make steel and iron castings, malleable chain links of all sizes and expansion joints for gas and oil pipings. The officers of the company are A. P. Turner, president; Chas. A. Post, vice president; L. Treadway, secretary, and Wm. F. Kerr, manager.

The S. Jarvis Adams Co., Pittsburgh, has installed a 20-ton open-hearth furnace in its plant at Midland, Pa., and steel castings, as well as gray iron castings will constitute the output of these works in the future. Changes have been made recently in the organization and the officers are as follows: J. Ramsey-Speer, president; Joseph McK. Speer, vice president; Charles McKnight, treasurer; Clyde Brooks, secretary; F. B. Foster, manager of sales, and W. L. Forster, general superintendent.

New Construction

The Jewell Steel & Malleable Co., Buffalo, will erect a one-story addition, 60 x 135 feet, to its present foundry.

The Barry Mfg. Co., Muscatine, Ia., contemplates the erection of a concrete and steel building, 60 x 140 feet, which will be used as a foundry.

The Interstate Foundry Co., Cleveland, will enlarge its plant by the erection of a new core department. The building will be 40 x 145 feet, three stories high.

The Manufacturers' Foundry Co., Waterbury, Conn., manufacturer of gray iron castings, is enlarging its cupola room for the purpose of installing an additional cupola and blower.

The Pittsburgh Foundry & Machine Co., Salem, O., will rebuild its plant recently destroyed by fire. The new plant will be of steel construction, having about the same capacity as the one destroyed.

The Graf Stove & Range Co., Louisville, Ky., incorporated with a capital of $100,000, will erect a stove foundry as soon as a suitable site can be secured. H. J. Graf, of the Graf-Webb Iron Mfg. Co., is president of the new company.

The Murphy Iron Works, Detroit, is erecting a foundry, 112 x 280 feet, which will be used exclusively for making castings used in the manufacture of the Murphy automatic smokeless furnace. Considerable foundry equipment will be purchased.

The Canton Steel Foundry Co., Canton, O., formerly the Shull Steel Castings & Mfg. Co., will enlarge its plant by the erection of a foundry, 60 x 180 feet, and an open-hearth building, 60 x 280 feet. Four cranes will be added to the six now in operation and a 30-ton open-hearth furnace will be erected.

The Scullin-Gallagher Iron & Steel Co., St. Louis, manufacturer of open-hearth steel castings, recently has awarded contracts for the erection of a new chipping shop, 100 feet wide and 600 feet long. The contract for three 10-ton cranes was awarded to the Alliance Machine Co., Alliance, O.

The Gurney Electric Elevator Co. will build a new plant at Honesdale, Pa., plans for which are being prepared by Day & Zimmerman, engineers, Philadelphia. The works will contain about 50,000 square feet of floor space and will include a gray iron foundry, machine and woodworking shops and a heating plant.

The Lebanon Steel Castings Co., Lebanon, Pa., is enlarging the chipping and molding departments of its foundry, which will double its present output. Additional grinding and cold saw, cutting-off machinery will be installed. The plant, when completed, will have a capacity of 50 to 60 tons of crucible steel castings per month.

The Michigan Steel Casting Co., Detroit, will install a two-ton, two-piece converter for making steel for casting purposes. A 54-inch cupola also is being added, with the necessary blowers and equipment which are being furnished by the Tropenas Converter Co., New York City. At the present time this company is operating two converters, and owing to the heavy demands for steel castings, it has been compelled to add another steel-making unit.

The Hutchinson Foundry & Machine Works Co., Hutchinson, Kans., will erect a new plant on the southwest corner of Avenue D and Washington street. The machine shops will have a frontage of 150 feet on Washington street and will extend back 70 feet facing Washington. The foundry will face on Avenue D and will occupy an ell of the main building, 50 x 80 feet. Pattern and pattern storage buildings will also be erected.

The Home Stove Works, Chicago, is erecting two new buildings, one of which will be 33 x 96 x 210 feet, four stories. The first floor will be employed as an assembling or mounting department, the second floor being devoted to the nickeling and polishing departments and the third floor will be used for the shipping department while the fourth will be utilized for storage purposes. The other building will be a one-story foundry, 96 x 136 x 177 feet, 7 inches and will be used for making piano plates and stove work.

The National Brake & Electric Co., Milwaukee, is having plans prepared for a new iron foundry, the main building of which will be 80 x 240 feet, running north and south and having two wings extending west at the north and south end of the main foundry. Each wing will be 60 x 120 feet, two stories and an extension, 40 x 240 feet, will also be added on the east of the main foundry. One 15 to 20-ton, 80-foot span traveling crane, two 5-ton jib cranes, one 40-foot span traveling crane and one 20-foot span traveling crane will be installed.

Maher & Flockhart, Newark, N. J., have purchased additional property adjoining their plant, which includes several buildings, one of which is a four-story structure, 50 x 100 feet. This building is being remodeled for the storage of patterns. In an extension to this building an open-hearth furnace, with a capacity of 10 tons, for melting iron will be installed. The furnace will be oil-fired and it is believed that a purer grade of iron can be obtained than can be melted in a cupola. An addition also will be built to the foundry, 87 x 90 feet. Three additional sand blast machines will be installed.

Among the Brass Founders

The Safety Equipment Mfg. Co., Chicago, is erecting a machine shop, 35 x 50 feet, and a brass foundry, 40 x 125 feet.

The Lycoming Foundry & Machine Co., Williamsport, Pa., is erecting a new aluminum foundry, 60 x 160 feet, with an addition to its present gray iron foundry, 60 x 300 feet.

The Cleveland Brass Mfg. Co., Cleveland, recently incorporated with a capital of $150,000, will succeed the Cleveland Brass & Bronze Co., manufacturer of plumbers' brass goods and brass specialties. The company is erecting a four-story addition, 40 x 120 feet, to its plant at 4606 Hamilton avenue.